

Traffic Solutions
Sopers Lane, Poole, Dorset, BH17 7ER
United Kingdom
+44 (0)1202 782000
www.siemens.co.uk/traffic

ST750

General Handbook

PREPARED: Andy White
FUNCTION: Engineering Manager

THIS DOCUMENT IS ELECTRONICALLY HELD AND APPROVED

© Siemens plc. 2011 All rights reserved.

The information contained herein is the property of Siemens plc and is supplied without liability for errors or omissions. No part may be reproduced or used except as authorised by contract or other written permission. The copyright and the foregoing restriction on reproduction and use extend to all media in which the information may be embodied.

The names of products of third parties named in this document may be trademarks of their respective owners.

Change History

Issue	Change Ref	Date
1	First Issue	11 February 2009
2	TS004961	27 February 2009
3	TS005209	28 August 2009
4	TS005637	31 August 2010
5	TS005954	10 February 2011

SAFETY INFORMATION

HEALTH AND SAFETY AT WORK

DISCONNECT ALL POWER TO THE CABINET BEFORE REMOVING OR INSTALLING ANY EQUIPMENT INTO THE CABINET.

Safety of Maintenance Personnel

In the interests of health and safety, when using or servicing this equipment the following instructions must be noted and adhered to:

- (i) Only skilled or instructed personnel with relevant technical knowledge and experience, who are also familiar with the safety procedures required when dealing with modern electrical/electronic equipment are to be allowed to use and/or work on the equipment. All work shall be performed in accordance with the Electricity at Work Regulations 1989.
- (ii) Such personnel must take heed of all relevant notes, cautions and warnings in this Handbook and any other Document or Handbook associated with the equipment including, but not restricted to, the following:
 - (a) The equipment must be correctly connected to the specified incoming power supply.
 - (b) The equipment must be disconnected/isolated from the incoming power supply before removing any protective covers or working on any part from which the protective covers have been removed.
 - (c) This equipment contains a Lithium battery that must be disposed of in a safe manner. If in doubt as to the correct procedure refer to the instructions contained on page 6 of this document.
 - (d) Any power tools must be regularly inspected and tested.
 - (e) Any ladders used must be inspected before use to ensure they are sound and not damaged.
 - (f) When using a ladder, before climbing it, ensure that it is erected properly and is not liable to collapse or move. If using a ladder near a carriageway ensure that the area is properly coned and signed.
 - (g) Any personnel working on site must wear the appropriate protective clothing, e.g. reflective vests, etc.

In the event of more than one person working on the Controller and its associated signal heads, the Mains Supply to the Cabinet Assembly must be switched off. If the master switch has a lock, this should be used to keep the switch locked in the 'off' position.

Warning

When working on the controller in countries where both sides of the incoming supply are above earth potential, the Master Switch or Circuit Breaker on the rear of the Cabinet should be opened, since the Controller Switch on the front of the ST750 does not isolate both sides of the supply.

When re-commissioning signals, the following sequence is recommended:

1. Switch OFF the Cabinet Assembly at the master switch
2. Switch ON the lamps on-off switch on the manual panel
3. Switch ON the Cabinet Assembly at the master switch.

More specific safety information is given within the text of the handbook, where it relates to particular activities or situations.

WARNING

To isolate the equipment the master switch must be in the “Off” position.

Switching either the Controller or the Manual Panel Signals On/Off switch to “Off” does not guarantee isolation of the equipment.

WARNING

These (this) controller(s) require specific configuration to enable them (it) to function correctly when installed.

The configuration process is a complex activity should only be carried out by persons who are adequately trained, have a full understanding of the needs of the county or region where the controller is to be used and are experienced in the tasks to be undertaken.

Safety of Road Users

It is important that all personnel are aware of the dangers to road users that could arise during repair and maintenance of traffic control equipment.

Ensure that the crossing area is coned and signed as necessary to warn motorists and pedestrians of any dangers and to help protect the personnel working on the site.

Whilst repairing signals which are in an "all-out" condition, care must be taken to ensure that no spurious signals are lit during testing which could mislead drivers or pedestrians. Particular care is required where pedestrian audible devices are installed, to ensure that no false indications are given during, for example, cable testing. Personnel should also ensure the safety of pedestrians, especially children, who may come into contact with parts of the ST750 Rack Assembly, Cabinet Assembly or signal poles.

Safety Warning - Lithium Battery

This equipment contains a Lithium battery.

Do not short circuit, recharge, puncture, take apart, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of the product, otherwise there is a risk of fire or explosion.

Batteries should be handled and stored carefully to avoid short circuits. Do not store in disorderly fashion, or allow metal objects to be mixed with stored batteries. Keep batteries between -30°C and 35°C for prolonged storage.

The batteries are sealed units which are not hazardous when used according to these recommendations. Do not breathe vapours or touch any internal material with bare hands.

Battery disposal method should be in accordance with local, state and government regulations. In many countries, batteries should not be disposed of into ordinary household waste. They must be recycled properly to protect the environment and to cut down on the waste of precious resources.

TABLE OF CONTENTS

1. INTRODUCTION.....	11
1.1 PURPOSE OF THIS HANDBOOK.....	11
1.2 CONTACT US.....	11
1.3 REFERENCE DOCUMENTS.....	11
1.3.1 NON-ESSENTIAL DOCUMENTS – INTERSECTION DESIGN	11
1.3.2 ESSENTIAL DOCUMENTS – CONTROLLER.....	11
1.3.3 ESSENTIAL DOCUMENTS – CABLING.....	12
1.3.4 ESSENTIAL DOCUMENTS – ANCILLARY EQUIPMENT	12
1.4 PRE-REQUISITES.....	12
1.4.1 QUALIFICATIONS.....	12
1.4.2 REQUIRED TOOLS.....	13
1.5 DEFINITIONS	13
1.6 ABBREVIATIONS	14
 2. SPECIFICATION	 15
2.1 EQUIPMENT INTRODUCTION.....	15
2.1.1 SINGLE PEDESTRIAN CONTROLLER.....	16
2.1.2 DUAL PEDESTRIAN CONTROLLER	16
2.1.3 SMALL NON-UK CONTROLLER	16
2.1.4 CONTROLLER EXPANSION	16
2.1.5 TYPES OF PEDESTRIAN CONTROLLER	17
2.1.6 DIFFERENCES BETWEEN THE ST750 AND THE ST700.....	17
2.1.7 SPARES COMPATIBILITY BETWEEN THE ST750 AND ST700.....	19
2.2 BASIC SYSTEM OVERVIEW	19
2.3 MAINS SUPPLY.....	20
2.3.1 ELECTRICAL NOISE	20
2.4 DETERMINATION OF LOADING AND POWER CONSUMPTION	21
2.4.1 ST750 SUPPLY REQUIREMENTS.....	21
2.4.2 LAMP DRIVE CAPABILITY	22
2.4.3 CALCULATION OF AVERAGE SIGNAL LAMP POWER	23
2.4.4 INTERSECTION'S POWER REQUIREMENTS FOR RUNNING COSTS ESTIMATE.....	24
2.4.5 CONNECTION TO UN-METERED SUPPLIES (UMS)	25
2.4.6 DETECTOR POWER SUPPLIES.....	25
2.4.7 AUDIBLE AND TACTILE SUPPLIES	26
2.5 PHASES.....	27
2.6 STAGES.....	27
2.7 TIMINGS	27
2.7.1 TOLERANCE.....	27
2.8 MASTER TIME CLOCK AND CLF SUMMARY	28
2.9 MODES OF OPERATION.....	28
2.10 CABINET CHARACTERISTICS	29
2.11 ENVIRONMENTAL	30
2.11.1 TEMPERATURE.....	30
2.11.2 ATMOSPHERIC	30
2.11.3 HUMIDITY	30
 3. PEDESTRIAN FACILITIES	 31
3.1 TYPES OF PEDESTRIAN CROSSINGS.....	31
3.1.1 PELICAN CROSSING	31
3.1.2 NEAR SIDED PEDESTRIAN CROSSING	31
3.1.3 FAR SIDED PEDESTRIAN CROSSING	32
3.1.4 ON-CROSSING DETECTORS.....	33
3.2 PEDESTRIAN MODES OF OPERATION	34
3.2.1 FIXED VEHICLE PERIOD.....	34
3.2.2 VEHICLE ACTUATED	34
3.2.3 VEHICLE ACTUATED WITH PRE-TIMED MAXIMUM (PTM)	35
3.2.4 LINKED OPERATION.....	35

3.3 PEDESTRIAN DEMAND CONTROL.....	36
3.3.1 INTRODUCTION	36
3.3.2 PEDESTRIAN DEMAND ACCEPTANCE	38
3.3.3 PEDESTRIAN DEMAND DELAY (PDD)	38
3.3.4 PEDESTRIAN DEMAND CANCEL (PDX).....	39
3.3.5 KERBSIDE DETECTOR (MAT) TESTING.....	39
4. HARDWARE OVERVIEW	41
4.1 CABINET OPTIONS	41
4.2 THE ST750 RACK ASSEMBLY	44
4.3 ST750 CPU LEDS.....	46
4.3.1 STATUS LED GROUP	46
4.3.2 SIGNAL LED GROUP	47
4.4 MASTER SWITCH ASSEMBLY	47
4.5 FUSES	48
4.6 MAINS DIMMING TRANSFORMER.....	48
4.7 MANUAL PANEL	48
4.8 DETECTOR MOUNTING.....	49
4.8.1 DETECTOR BACK PLANE IN SMALL OUTER CASE	49
4.8.2 DETECTOR BACK PLANES IN LARGE OUTER CASE	51
4.9 2A DETECTOR SUPPLY KIT	51
4.10 GEMINI ²	52
4.10.1 GEMINI ² IN SMALL OUTER CASE.....	52
4.10.2 GEMINI IN LARGE OUTER CASE.....	53
4.11 TC12 OTU.....	55
4.11.1 INTEGRAL TC12 OTU IN SMALL OR LARGE OUTER CASES	55
4.11.2 FREE STANDING TC12 OTU IN SMALL OUTER CASE	55
4.11.3 FREESTANDING TC12 OTU IN A LARGE OUTER CASE	57
4.12 SDE/SA	58
5. INSTALLATION AND COMMISSIONING.....	59
5.1 PRE-INSTALLATION CHECKS.....	59
5.1.1 HARDWARE CHECK	59
5.1.2 DIMMING TRANSFORMER TAP SETTING	59
5.2 ST750 CABINET PREPARATION	60
5.3 SITE SUITABILITY.....	60
5.4 INSTALLATION OF THE ST750 SMALL CABINET	61
5.4.1 INSTALL CONTROLLER CABINET AND STOOL.....	62
5.5 INSTALLATION OF THE ST750 LARGE CABINET.....	63
5.5.1 REMOVE THE CONTROLLER CABINET FROM THE STOOL	64
5.5.2 INSTALL THE STOOL.....	64
5.6 CABLING TO THE ST750 SMALL AND LARGE CABINETS	65
5.7 ON SITE CABLE TESTING	67
5.8 FIT THE CABINET TO THE STOOL	68
5.9 BACK FILL AND IN-FILL THE STOOL.....	68
5.10 SEALING THE BASE OF THE CONTROLLER OUTER CASE	68
5.11 CABLE ROUTING & TERMINATION	69
5.11.1 PHASE DRIVE PCB TERMINAL BLOCKS	70
5.11.2 ST750 CPU PCB TERMINAL BLOCKS	79
5.12 REGULATORY SIGNS MONITORING	84
5.13 PCB SWITCHES, FUSES, LINKS AND FIRMWARE.....	84
5.13.1 CPU PCB SWITCH AND LINK SETUP.....	85
5.13.2 PHASE DRIVE PCB SWITCHES, LINKS AND FUSES SETUP.....	88
5.14 REFITTING THE LID	90
5.15 ON-SITE ST750 TESTING	90
5.16 ST750 START-UP SEQUENCE	92
5.17 COMMON RETURNS FOR PUSH BUTTON	93
5.18 COMMON RETURNS FOR DETECTORS.....	93
6. FITTING THE ST750 RACK ASSEMBLY INTO ALTERNATIVE CABINETS	94

7. ROUTINE MAINTENANCE PROCEDURES.....	95
7.1 ROUTINE INSPECTION OF SIGNAL EQUIPMENT	95
7.2 ROUTINE INSPECTION AND ELECTRICAL TESTING OF ST750	95
7.3 ROUTINE SETUP CHECK	97
7.4 REPLACEMENT OF PCBS	97
7.4.1 SAFETY REQUIREMENTS.....	98
7.4.2 GENERAL REQUIREMENTS	98
7.4.3 ACCESS TO PCBS IN ST750 CABINET ASSEMBLY	98
7.4.4 ACCESS TO PCBS IN OTHER OUTERCASES.....	99
7.4.5 REPLACEMENT OF CPU PCB.....	99
7.4.6 REPLACEMENT OF POWER/PHASE ASSEMBLY	99
7.4.7 REPLACEMENT OF MANUAL PANEL PCB	100
7.4.8 REPLACEMENT OF EXPANSION I/O OR OTU PCB	101
7.5 REPLACEMENT OF MAINS POWER SUPPLY UNIT	101
7.6 REPLACING OTHER COMPONENTS.....	101
 8. SELF-TEST FACILITY	 102
 APPENDIX A - PART NUMBERS AND SPARES LIST	 108
A.1 – PART NUMBERS	108
A.2 – SPARES LIST	109
A.2.1 – PCBS.....	109
A.2.2 – FUSES.....	110
A.2.3 – CABLES	110
A.2.4 – OTHER SPARES	110
A.3 - FUSE RATINGS AND POSITIONS.....	110

Table of Figures

Figure 1 –Theoretical Crossing.....	23
Figure 2 – Ped Demand Processing	37
Figure 3 – ST750 in Small Outer Case with Detector Swing Frame	41
Figure 4 – ST750 in Small Outer Case configured with optional 11" Swing Frame	42
Figure 5 – ST750 in Large Outer Case configured with optional 19" Swing Frame	43
Figure 6 – ST750 Rack Assembly	44
Figure 7 – CPU and Phase Driver Cards.....	45
Figure 8 – I.O Expansion Card	45
Figure 9 - CPU LEDs	46
Figure 10 – Master Switch Assembly.....	47
Figure 11 – Mains Dimming Transformer	48
Figure 12 – Manual Panel (full panel shown)	48
Figure 13 – Single Detector Backplanes	49
Figure 14 – Detector Swing Frame	50
Figure 15 – Detectors in 11" Swing Frame	50
Figure 16 – Detectors in a 19" Swing Frame	51
Figure 17 - 2A Detector Supply Kit	51
Figure 18 - Gemini in a Detector Swing Frame	52
Figure 19 - Gemini in an 11" Swing Frame.....	53
Figure 20 - Gemini in a Large Outer Case.....	53
Figure 21 - Freestanding TC12 OTU in Small Outer Case.....	56
Figure 22 - Free Standing TC12 OTU in Large Outer Case.....	57
Figure 23 - Dimming Transformer Tap Selection.....	60
Figure 24 - Stool Installation, Small Cabinet.....	63
Figure 25 - Stool Installation, Large Cabinet	65
Figure 26 - Termination of Armoured CABLE to CET bar	67
Figure 27 - Allocation of Red Lamp Monitor Channels for ST750 Controllers without LV CLS (NLM) monitoring	73

Figure 28 - Allocation of Red Lamp Monitor Channels for ST750LED Controllers with LV CLS (NLM) monitoring	74
Figure 29 - Dimming Transformer Tap Selection.....	77
Figure 30 - Connector PL5.....	78
Figure 31 - Connector PL3.....	81
Figure 32 - Connector PL7.....	82
Figure 33 - Connector PL2.....	83
Figure 34 - Connector PL6.....	84
Figure 35 – CPU PCB.....	85
Figure 36 – Flash Rate Settings	86
Figure 37 – Phase Output Flash Selection	87
Figure 38 – Relay Output Resistance Selection	87
Figure 39 – ST750 Phase Drive PCB Assembly	88
Figure 40 – Links LK1 to LK4.....	90
Figure 41 – Handset.....	103
Figure 42 - Fuse Ratings	111

Tables

Table 1 – ST750 Supply Requirements	22
Table 2 – ST750 Lamp Drive Capability	22
Table 3 – ST750 Lamp Load (Watts).....	22
Table 4 – Detector Power Consumption.....	23
Table 5 – ST750 Cabinet Assembly Size and Weight.....	29
Table 6 – Phase Drive PL6 Connector	70
Table 7 – Phase Drive PL7 Connector	71
Table 8 – Phase Drive PL8 Connector for ST750 Phase Driver PCB (<u>6 Phase</u>).....	72
Table 9 – Phase Drive SK1 Connector	75
Table 10 – Phase Drive PL1 Connector	75
Table 11 – Phase Drive SK2 Connector No Dimming.....	76
Table 12 – Phase Drive SK2 48V Dimming Connections.....	76
Table 13 – Phase Drive PL5 Connector	77
Table 14 – Processor Card PL3 Connector.....	80
Table 15 – Processor Card PL7 Connector.....	81
Table 16 – Processor Card PL2 Connector.....	82
Table 17 – Processor Card PL6 Connector.....	83
LAST PAGE.....	112

1. INTRODUCTION

1.1 Purpose of this handbook

The purpose of this handbook is to give a general description and specification of the ST750 Rack Assembly and the procedures for its Installation, Commissioning and Maintenance in the ST750 Cabinet Assembly and other Cabinets. Also provided is guidance on testing and maintenance procedures.

Note

Ongoing development means that some of the delivered items may differ in detail from the information included in this handbook.

1.2 Contact Us

If you have any comments on this handbook, or need any further information, you can contact us at trafficwebmaster.stc@siemens.com.

1.3 Reference Documents

1.3.1 Non-Essential Documents – Intersection Design

	Publisher	Reference Number	Document Title
1.	Siemens	667/DS/20664/000	Traffic Signal Junction Cable Design & Certification
2.	Siemens	667/HE/31699/000	Loop Inductance and Turns Calculation Spreadsheet
3.	Siemens	667/DZ/33750/000	ST750 Family Tree

1.3.2 Essential Documents – Controller

	Publisher	Reference Number	Document Title
4.	Siemens	667/SU/32900/000	ST900/750 Family Firmware and Hardware Configurations
5.	Siemens	667/HH/32900/000	ST900/750 Family Handset Handbook
6.	Siemens	667/HB/32900/000	ST900 General Handbook
7.	Siemens	667/HB/33750/000	ST750 General Handbook (This document)
8.	Siemens	667/DA/27880/000	ST750 UK Power Circuit Diagram
9.	Siemens	667/DA/27880/006	ST750 Non-UK Power Circuit Diagram
10.	Siemens	667/GA/33750/ETC	ST750 ELV Controller Cabinet Cabling
11.	Siemens	667/CC/32750/000	ST750 Family Controller Configuration
12.	Siemens	667/HB/32921/007	Handbook Supplement for Monitoring Helios CLS (NLM) Signals

1.3.3 Essential Documents – Cabling

	Publisher	Reference Number	Document Title
13.	Siemens	667/HE/20664/000	Installation and Commissioning Handbook - Installation Testing (General)
14.	Siemens	667/HE/20663/000	Loop Detector and Cable Terminations – Installation and Commissioning

1.3.4 Essential Documents – Ancillary Equipment

	Publisher	Reference Number	Document Title
15.	Siemens	667/HE/20662/000	Installation & Commissioning – Signals & Poles
16.	Siemens	667/HE/20665/000	Installation and Commissioning Handbook 5 - Above Ground Detectors
17.	Siemens	667/HB/43100/000	TC12 General Handbook
18.	Siemens	667/HB/32600/000	Gemini ² Traffic Outstation Handbook
19.	Siemens	667/HB/27663/000	ST4R/ST4S Loop Detector Handbook
20.	Siemens	667/HB/22380/000	TCSU/TfL IMU Handbook
21.	Siemens	667/CC/29000/002	24 Volt Power Distribution Small Cabinet
22.	Siemens	667/CC/29000/003	24Volt Power Distribution Large Cabinet

1.4 Pre-Requisites

Anyone undertaking installation, commissioning and first line maintenance on the ST750 controller will also need the ST900/750 Family Handset Handbook (667/HH/32900/000). This provides details of how to access the controller handset port through which the user communicates with the controller.

1.4.1 Qualifications

Only skilled or instructed personnel with relevant technical knowledge and experience, who are also familiar with the safety procedures required when dealing with modern electrical/electronic equipment, are to be allowed to use and/or work on the equipment. All work shall be performed in accordance with the Electricity at Work Regulations 1989 or the relevant local, state and government regulations.

Any personnel working on the ST750 Controller should have completed the following training courses:

- M608 – Pedestrian Traffic Controller Maintenance (ST750 & ST750ELV)
- Personnel should also comply with the Highways National Sector Scheme Competency Requirements

Training requirements for non UK users may be different

1.4.2 REQUIRED TOOLS

In addition to a standard Engineer's tool kit, the following tools are required when carrying out any work on the ST750 Controller:

	Part Number
T-bar key	667/2/20234/000
S-18 key – Main Cabinet	4/MC 289
Serial handset Techterm, or	667/4/13296/001
Old Oyster handset, or	667/4/13296/000
Larger Screened Oyster handset	667/4/13296/002
Manual Panel key Type 900	667/4/13651/000

1.5 Definitions

Cabinet Assembly	The ST750 Rack Assembly installed in the ST750 Cabinet with associated equipment mounting frame, mounting stool, mains distribution, power supplies, electronic control and phase switching.
Configuration data (also referred to as customer's data) and site specification	Data supplied by customer as to how the ST750 is to function.
EM	Controller identification number (ElectroMatic).
Firmware EPROM	This goes on the Main Processor Board.
Pedestrian stream	A group of Red, Amber and Green traffic signals plus their associated Red Man, Green Man and Waits of the pedestrian signals.
Rack Assembly	This consists of a box like frame with a plate hinge on the front that acts as an access door. The Phase Drive PCB and PSU are mounted behind the ST750 CPU PCB.
STS (Site to Scale)	This is a scale drawing of the intersection including Cabinet Assembly position, detector loop positions and specification, cable routing and poles with signal head arrangements.
Works Specification	Document produced by Siemens, which details the hardware required for the ST750 and includes Site Data, usually in the form of a printout of the data entered on the configurator.

1.6 Abbreviations

AC	Alternating Current
AGD	Above Ground Detector
BIT	Binary digit (i.e. `0' or `1')
CET	Cable Earth Terminal
CLF	Cableless Linking Facility
CLS	Central Light Source
CPU	Central Processing Unit
DC	Direct Current
DFM	Detector Fault Monitor
ELV	Extra Low Voltage
EPROM	Erasable Programmable Read Only Memory
FT	Fixed Time
IC	Integrated Circuit
IC4	ST800 Configurator
I/O	Input/Output
I/P	Input
LED	Light Emitting Diode
LV	Low Voltage
ms	milliseconds
NLM	No LMF Module
OMU	Outstation Monitor Unit
OTU	Outstation Transmission Unit
PCB	Printed Circuit board
PLD	Programmable Logic Device
PROM	Programmable Read Only Memory
PSU	Power Supply Unit
RAM	Random Access Memory
RCD	Residual Current Device
RFL	Reset Fault Log (handset command)
RMS	Root Mean Square
ROW	Right Of Way
RTC	Real Time Clock
SA	Speed Assessment
SDE	Speed Discrimination Equipment
ST	Self Tuning
UTC	Urban Traffic Control
UTMC	Urban Traffic Management and Control
VA	Vehicle Actuated

2. SPECIFICATION

The Specification that follows is for the ST750 Cabinet Assembly. Where appropriate it also applies to the ST750 Rack Assembly as supplied for installation in another Cabinet.

Non-UK specifications are detailed where they differ from standard UK specifications.

2.1 Equipment Introduction

The ST750 is a Pedestrian Controller and Small Non-UK Traffic Controller and can be supplied in either small or large single-door outer cases.

It can be supplied as

- Single Pedestrian controller (2 Phase)
- Dual Pedestrian Controller (4 Phase)
- Small Non-UK Controller (6 Phase)

Generally it comes as a fully fitted Cabinet Assembly with its own equipment, mounting stool, mains distribution, power supplies, electronic control and phase switching

This ST750 Cabinet Assembly can also accommodate Detectors, I/O PCB, OTU PCB, an OMU Assembly, Manual Panel, Master Switch Assembly and a Dimming Transformer.

It may also be fitted as a “Cuckoo” into many existing cabinets, when supplied as a Rack Assembly consisting of the power/phase assembly and a CPU. There are a number of conversion kits available that enable it to be installed into other cabinets.

The ST750's electronics consist of three PCBs:

- The CPU PCB that contains most of the logic, which controls the system and the extra low voltage inputs and outputs, i.e. detector inputs, audible outputs, etc.
- The Phase Drive PCB that contains most of the Mains distributions, the triac phase drive outputs, voltage and current monitoring.
- The PSU (24V) that provides the main power supply for the ST750.

The CPU PCB operates under the control of both a main and a secondary processor. The main processor is a Motorola 68340, which runs the firmware controlling all the functions of the ST750's operations. The secondary processor is an Intel 80C31 controlling all the phase output switching and voltage monitoring. The two processors communicate with each other through shared RAM. This dual processing provides additional safety features, as each processor continually

monitors the actions of the other, and independently turns off the lights to the motorists and pedestrians if either processor causes an error.

The software is written in a powerful high level language that allows the implementation of the ST750's extensive facilities. The ST750 offers both Single and Dual Pedestrian operation and up to a 6 Phase Traffic Controller operation, each with solid state switching.

The power/phase assembly with its associated ST750 Phase Drive PCB and PSU can drive up to 18 signal outputs with 230V at 4A. The pedestrian signals are configurable to supply either 230V or 48V. Each of the two pedestrian streams has current monitoring on two separate vehicle approaches for Red, Amber and Green lamps plus one unmonitored approach Red lamp only. This provides TR2500A compatible Red lamp monitoring for the Red lamps and lamp monitoring for the Amber and Green lamps.

Note that a new ST750LED Phase Driver PCB provides lower current outputs, and can monitor Helios LV CLS (NLM) signals. See 667/HB/32921/007 in Section 1.3.2 for further details.

The controller conforms to the UK Highways Agency specification TR2500A.

2.1.1 Single Pedestrian Controller

The ST750 Single Pedestrian Controller consists of one vehicle phase and one pedestrian phase with a minimal set of I/O to perform all the functions of 2 phase Pelican, Puffin or Toucan. These consist of 32 buffered inputs, 8 isolated relay outputs, 2 Audible outputs and 1 Tactile Interlock output.

2.1.2 Dual Pedestrian Controller

The ST750 Dual Pedestrian Controller consists of 2 vehicle phases and 2 pedestrian phases with a minimal set of I/O to perform all the functions of 4 phase Pelican, Puffin or Toucan. These consist of 32 buffered inputs, 8 isolated relay outputs, 4 Audible outputs and 2 Tactile Interlock outputs.

2.1.3 Small Non-UK Controller

The ST750 Small Non-UK Controller consists of a 6 Phase Traffic Intersection Controller. It is similar to the Pedestrian controllers, except in the following areas:

- It has 6 Phases
- It has no built in current lamp monitoring facilities
- It cannot be configured to output 48V from any of its Phase Drive outputs.

2.1.4 Controller Expansion

Expansion may be achieved by adding combinations of the following equipment:

- Inputs/Outputs PCB

This board can expand the inputs/outputs as follows:

16 Inputs

16 Outputs

- Detectors

These can be Siemens, Microsense or Sarasota self tuning units. Up to 4 units can be accommodated in the ST750 cabinet, each unit having four detector channels.

- Ancillary Equipment

OTU – Outstation Transmission Unit for Tele Command 12.

OMU – Outstation Monitoring Unit for Remote Monitoring System.

2.1.5 Types of Pedestrian Controller

A number of different types of pedestrian crossings are available on the ST750. The following table lists the different types of 'stand-alone' pedestrian crossings detailed in TR2500A:

Type of Crossing	Ped. Signal Position	Pedestrian to Vehicle Clearance Period
"Pelican"	Far-side	Vehicle Flashing Amber Pedestrian Flashing Green
"Puffin"	Near-side	Vehicle Red Pedestrian Red
"Pedestrian"	Far-side	Vehicle Red Pedestrian Blackout
"Toucan"	Far-side	Vehicle Red Pedestrian Blackout
"Toucan"	Near-side	Vehicle Red Pedestrian Red

These are described in more detail in sections 3.1.1 to 3.1.3 titled 'Pelican Crossing', 'Near Sided Pedestrian Crossing' (which covers both 'Puffin' and 'Toucan') and 'Far Sided Pedestrian Crossing' (which covers both 'Pedestrian' and 'Toucan').

The 'on-crossing detectors' are described in section 3.1.4, while 'kerbside detectors' are described in section 3.3.

2.1.6 Differences between the ST750 and the ST700

The ST750 differs functionally from the ST700 in the following ways:

- CPU – A new variant of the CPU board is required for operation in the ST750. Although the ST700 and ST750 CPU Cards look very similar, the ST750 requires at least 512KB of RAM and only 256KB is fitted to most ST700 CPU Cards.

Note

The ST750 requires a CPU board with a /003 part number suffix for UK applications or /007 for Non-UK applications. Earlier i.e. ST700 CPU boards can NOT be used in an ST750

- PHP – PB801 and the ST750 require PB817 issue 5 or later; PB800 and the ST700 can use PB817 issue 3 or later (which includes PB817 issue 5).
- IO – PB801 firmware on the ST750 controller continues to use the I/O built in to the CPU Card, with the option of adding one ST800 style Expansion I/O Board.
- SDE – Integral SDE/SA is still used, using the I/O on the CPU Card. The SDE/SA Card on the Extended System Bus is not supported by the firmware.
- Config – The standard stand-alone pedestrian configurations have changed. A list of these can be found in the IC4 ReadMe file (v11) and in this document (section 5.15). A list of the significant changes between a new ST750 standard configuration and its original ST700 configuration is included in its Special Instructions (from issue 2).
- Kerbsides – As required by TR2500A in the UK, pushbuttons now insert a latched demand if they are pressed while their associated kerbside detector is inactive. If its associated kerbside detector is active, an unlatched demand is inserted (which is cancelled when all the kerbside detectors for the phase go inactive).
- DFM – DFM Faults on the individual I/O lines no longer appear in the Fault Log Data (FLD) and should be interrogated using the DSF handset command, which also displays the I/O Line Number and IC4 Name as well as indicating whether the input failed active (1) or inactive (0).
- DFM – The 'Reset DFM' facility (RDF=1 for example) will now clear the DFM fault flag (FLF12) and extinguish the System Error LED.
- Priority – The 'Automatic Reset' option of the Priority DFM Facility (PDR) has been improved so that a number of activations can be specified; the N'th activation is allowed and the fault is automatically cleared.
- Handset – The handset now auto-detects Eight Data Bits with No Parity Bit (8N) as well as continuing to support Seven Data Bits with an Even Parity Bit (7E) and 1200, 9600 and 19200 bps.
- Handset – Level 2 (PME) and Level 3 (Pushbutton) Access Timeout Periods are restarted if Level 2 or 3 data is changed (including RFL=1 for example) or the PME access code is re-entered.
- Config – The new CID handset command displays the firmware version (as entered on the IC4 Admin Screen) 'desired' by the configuration currently running a controller. The EM number and issue of the configuration is still visible using the CIC handset command.
- Config – The version of firmware required by a new configuration is checked before the existing configuration is erased. An "FLF 21:255 CPAT" fault logged if the new configuration requires a later version of firmware. The version required by the configuration which failed to load can be seen using the new CIE handset command.

2.1.7 Spares Compatibility between the ST750 and ST700

With the exception of the CPU board all components of the ST700 system are compatible with the ST750.

The ST750 requires a CPU board with a /003 part number suffix for UK applications or /007 for Non-UK applications. Earlier i.e. ST700 CPU boards can NOT be used in an ST750 due to the difference in RAM requirement.

If required, it is possible to use an ST750 CPU board to replace an existing or faulty ST700 CPU board but it is NOT possible to use an ST700 CPU board to replace an existing or faulty ST750 CPU board.

- To use an ST750 CPU in an ST700 it is required to change the firmware (PROM) to PB800. In this case, the relevant ST700 configuration will also need to be downloaded prior to use.

Warning!

On **NO ACCOUNT** is it permitted to downgrade an ST750 site to an ST700 site by changing the CPU board and associated firmware as an ST750 needs to conform to TR2500A which the ST700 **DOES NOT and CAN NOT**

2.2 BASIC SYSTEM OVERVIEW

Control	Main Microprocessor	Motorola 68340
	Firmware Storage	PROM (27C4002)
	Working Data Storage	Static RAM ($\geq 512K$) (Battery Backed)
	Secondary Microprocessor	Intel 80C31
	Firmware Storage	PROM (27C512)
	Working Data Storage	Internal to Microprocessor Device
	Inter-Processor Communications	Dual Port RAM 71321 (2K x 8)
	Hardware Fail Flash	Programmable Logic Device DIL Switches
Lamp Switching	Triac	Opto isolated, zero crossing No Load at dimming changeover
Conflict System	Main and Secondary Processors	Self Testing
Physical Hardware	CPU Card	PCB (244mm x 228mm)
	Phase Drive Card	PCB (253mm x 235mm)

2.3 MAINS SUPPLY

The following supply voltages may be used:

Nominal Voltage	Minimum Voltage	Maximum Voltage
100-240	85	264

It is recommended that the signals are supplied at the nominal mains voltage during Bright. I.e. For a 200V nominal supply, use 200V transformer/bulbs.

Note

THE PROSPECTIVE SHORT CIRCUIT CURRENT OF THE SUPPLY MUST NOT EXCEED 16,000 AMPS

Frequency:	50Hz $\pm$ 2Hz or 60Hz $\pm$ 2Hz
Mains Brownout:	Continues operating with up to 50ms loss of mains.
Mains Fail:	Restarts without operator intervention.
Battery Support:	Primary cell Lithium battery provides support for the following during power failures. (a) Clock Synchronisation (programmable up to 31 days). (b) Timing Data (greater than one year). A large capacitor provides support for a minimum of 4 hours if the battery has failed or is removed for replacement.
Dimming Voltage:	120V, 140V, 160V RMS **See Note 1
Solar Cell Input:	Dimming cannot be provided at mains supplies below 200V. Solar input operating voltages are as follows: Bright to Dim > 80V RMS Dim to Bright < 40V RMS

**Note 1. 160V is recommended for ST750LED Controllers. See 667/HB/32921/007 in Section 1.3.2 for further details.

The solar cell enables the ST750 to identify the light level and thus dim the signals when it is dark. The switch is set to operate at 55 lux and release at 110 lux. There is an optional time switch that can be used to regulate dimming control if required.

2.3.1 Electrical Noise

2.3.1.1 Supply Transients

The ST750 has been designed to withstand all the transients as defined in EN50293 on its supply.

2.3.1.2 Electrical Interference

The ST750 has been designed to create very little electrical interference, by the use of mains filters and solid state lamp switching control. The mains filters protect the incoming mains supply from any ST750 generated signals. The lamp switches are switched at zero crossover of the mains supply to reduce any switching transients.

The switching of the signals for dim/bright lamps changeover is controlled carefully to ensure the inductive switching does not cause interference.

The ST750 design is also extremely tolerant of externally generated electrical interference. Care is taken to avoid earth loops using a 'Star' point earthing system to which the cabinet, the internal metalwork, the junction cabling and the mains earth is connected.

The arrangement and partitioning of the equipment is carefully organised to reduce electrical noise.

The PCBs have two inner layer planes used for noise reduction. One is connected to zero voltage and the other connected to +5V, to form a complete screen with extensive capacitive de-coupling across the planes, which form the logic supplies. Unused inputs are connected to the logic supplies to ensure their logic state.

The phase switching (signal outputs) system has isolation provided by Opto-SCRs and zero crossing switched Triacs, for the mains switching. The circuit includes a snubber filter circuit that aids triac switch off and reduces noise when an inductive circuit is connected.

2.4 Determination of Loading and power consumption

Described below are the methods used to determine:

- how the ST750 supplies the total lamp load required
- the overall power used and thus estimate site running costs.

2.4.1 ST750 Supply Requirements

The typical supply requirements for an ST750 are:

	Power (Watts)
Single (2 Phase) or Dual (4 Phase) Pedestrian Controller	40 W
Non-UK Controller (6 Phase)	50 W

Table 1 – ST750 Supply Requirements

These requirements exclude lamp loads, detectors and OTU but include dimming transformer.

2.4.2 Lamp Drive Capability

	Max Current (Amps)	Max Power (Watts)
Maximum lamp current that the ST750 can supply including short-term illumination, i.e. red/amber.	8A	1840W
Maximum lamp load for each triac output on the phase drive PCB.	4A @ 230V or 4A @ 48V	920W or 192W

Table 2 – ST750 Lamp Drive Capability

Output Type	Lamp Load (Bright)	Maximum Quantity per triac output	Lamp Monitoring
230V Halogen	63W	14	Yes (Max 8 per sensor)
230V Siemens Helios CLS (With LMF)	28W	32	Yes (Max 8 per sensor)
230V Siemens Helios CLS NLM (No LMF)	14W	64	No*
48V 40W Wait	40W	4	Yes
48V 65W Wait	65W	3	Yes
48V Siemens Led Wait	7W	>8	No
48V Siemens Nearside Signal	18W	>8	No
48V Siemens Demand Indicator	6W	>8	No

Table 3 – ST750 Lamp Load (Watts)

*Note – ST750 LED Controllers allow these signals to be monitored. See 667/HB/32921/007 in Section 1.3.2 for further details.

	Power (Watts)
Siemens ST4R/ST4S detectors	2.4 watts per detector
Sarasota MTS36Z (2 channel) or MTS38Z (4 channel) detectors. (NB The power consumption is the same for both 2 and 4 channel units.)	3 watts per detector
Microsense detectors	6 watts per detector

Table 4 – Detector Power Consumption

Key:

- ◀ Traffic Red / Amber / Green Signal (Primary)
- ◀ Traffic Red / Amber / Green Signal (Secondary)
- ⏏ Pedestrian Red / Green Signal.
- Pedestrian Wait Indicator Box (on pole).

2 Detector Cards used but not shown

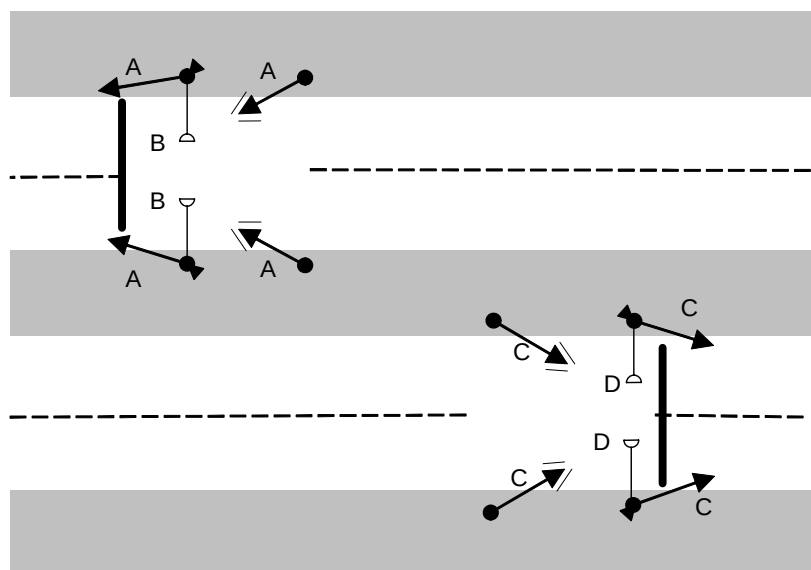


Figure 1 –Theoretical Crossing

2.4.3 Calculation of Average Signal Lamp Power

Calculate the total average signal lamp power as follows, using the bright figures in Table 3.

Total average signal lamp power is the sum of the signal lamp power plus the sum of the Wait indicator power.

Assuming that HI lamps take 63W each, the theoretical crossing (Figure 1) calculation would be:

One lamp per signal head @ 63W x 12 signal heads	=	756W
Wait indicators at 40W x 4	=	<u>160W</u>
Total average signal lamp power	=	<u>916W</u>

2.4.4 Intersection's Power Requirements for Running Costs Estimate

The following worked example is based upon a 230V/240V mains supply.

1. Calculate the total average controller power
 2. Calculate the total average lamp power for the junction as shown in 2.4.3
 3. Add the total average signal lamp power to the total average controller power
- Total average controller power is calculated as follows:

Average Controller power + Average Detector Power. See section 2.4.1.

A controller is rated at 40 watts (single or dual Pedestrian Controller).

For the purposes of this calculation Siemens ST4R/ST4Sdetector cards are rated at 3W per card.

This gives the total average junction power, which may be used to estimate running costs.

$$\text{i.e. Total average junction power} = \text{Total average signal lamp power} + \text{Total average controller power.}$$

Therefore for our theoretical crossing (Figure 1) the total average controller power is:

1 x Controller	40 W
2 x Siemens ST detectors	<u>6 W</u>
Total average controller power	<u>46 W</u>

Note: The controller power should also include any additional equipment supplied by the controller. This may include, for example, OTU, OMU or Auxiliary detector power supply.

For the total average junction power to aid with running cost estimates, the total average lamp power must be added to the total average controller power.

Total average junction power is calculated as follows:

Total average lamp power	916 W
Total average controller power	<u>46 W</u>
Total average junction power	<u>962 W</u>

If an estimate of running costs is required that includes the period of time that the signals are dimmed, this can be approximated as follows:

Total average Junction Power (Dimmed) is:

Total average Signal Power x (Dimmed Voltage / Nominal Mains voltage) plus
Total average Controller Power.

Therefore for the theoretical crossing in Figure 1:

Total average Junction Power (Dimmed)

$$\begin{aligned} &= (916\text{W} \times (160\text{V}/240\text{V})) + 46\text{W} \\ &= \mathbf{657\text{ W}} \end{aligned}$$

2.4.5 Connection to Un-Metered Supplies (UMS)

If the ST750 is to be connected to an unmetered supply (UMS) equipment codes for the agreed power consumption of the controller and all associated equipment may be found on the Elexon web site.

General information may be found at:

<http://www.elexon.co.uk/participating/unmeteredSupplies.aspx>

The actual charge codes may be found by following the link below, which is correct at the time of writing:

[http://www.elexon.co.uk/documents/Participating_in_the_Market/Unmetered Supplies - Operational Information/Unmetered Supplies Operational charge codes.xls](http://www.elexon.co.uk/documents/Participating_in_the_Market/Unmetered_Supplies_-_Operational_Information/Unmetered_Supplies_Operational_charge_codes.xls)

Note that a condition of using these codes is the creation of a full site inventory to create a costing for the supply of electricity. Details on this process may be found by following the link below, which is correct at the time of writing:

[http://www.elexon.co.uk/documents/Publications/Guidance_Notes - Unmetered Supplies/Charging Code Structure for UMS.pdf](http://www.elexon.co.uk/documents/Publications/Guidance_Notes_-_Unmetered_Supplies/Charging_Code_Structure_for_UMS.pdf)

2.4.6 Detector Power Supplies

The maximum current available for detectors on the ST750 is 0.6A at 24V DC. Refer to Table 4 or the Detector Handbooks for power consumption of detectors.

If more current is required, then power all detectors from a 24V AC Detector PSU. See Appendix A for part number. This PSU provides a maximum of 2A at 24V AC and is in the form of a transformer that can be mounted in three different positions:

- On the side of the Detector chassis using the four appropriate fixing holes
- On the back of the metal outer case frame near the mount position of the detector chassis, using the four appropriate fixing holes.

- On the left-hand side flange of the metal outer case frame just above the Master Switch Panel, using the four appropriate fixing holes.

2.4.7 Audible and Tactile Supplies

The Audible and Tactile power supplies on the ST750 are designed to provide a DC voltage between 10V and 24V, and typically provide a maximum of 100mA at 18V DC.

The ST750 provides three audible outputs on each of the 2 pedestrian phases. These are located on the CPU card PL2 (Phase D) and PL3 (Phase B).

Pin 11 is titled 'Tactile Phase n' – This is intended to interlock a tactile unit via the tactile PSU 'interlock' input to prevent operation on a Pelican during the flashing green man period where the 'Loud' output is configured to be time-switched.

Pin 12 is titled 'Audible Phase n Loud' – This is the normal connections to audibles. This output can be configured to be time-switched. If the tactile is also required to be switched then the tactile PSU 'interlock' input signal can be taken from this output.

Pin 13 is titled 'Audible Phase n Quiet' - This output is for the secondary physically muted audible.

Audible and Tactile units used must operate correctly over the voltage range 10 to 24V DC.

The units recommended and supplied by Siemens that meet this requirement are:

Audible:	667/4/04785/000 Highland Electronics type SC628P (previously Sonalert Mallory SC628P) Roxborough type SPCI535A4
Tactile:	667/7/17390/000 PELICAN currently Radix RS250 or RS252 667/7/17390/001 INTERSECTION currently Radix RS251 or RS252

NOTE – There are four main situations for audible/tactile control that arise on an ST750. These are –

1. Normal Audibles – The 'Loud' output is used.
2. Switched Audibles – The 'Loud' output can be used configured to switch off at selected times (e.g. at night). If the Tactiles are also to be switched then the tactile PSU 'interlock' input can be connected to this output.
3. A Muted Audible Output – The 'Quiet' output can be connected to the second audible. This audible will require a local physical muting method.
4. A Pelican With Flashing Green Man – The 'Loud' output is off during the flashing period. Thus the 'Loud' output is used to connect to the audibles and the tactile PSU 'interlock' signal input. If the 'Loud' output is configured

to be time switched, then the 'Tactile' output is used to control the tactile PSU interlock signal input.

2.5 PHASES

The ST750 Pedestrian Controller supports either 2 'Real' Phases for a single pedestrian crossing or 4 'Real' Phases for a dual pedestrian crossing.

The ST750 Small Non-UK Controller can support up to 6 'Real' Phases.

The ST750 software can support up to 32 phases, which can be any combination of real and software phases.

2.6 STAGES

The ST750 software supports up to 32 stages. Note that Stage 0 is normally ALL RED.

2.7 TIMINGS

All ST750 timings are transferred to battery supported RAM during initialisation. Once in RAM, most timings can be varied by handset commands. Once the configuration data has been loaded into the ST750, the same configuration cannot be loaded again. This prevents the accidental overwriting of any configuration data that may have been set up using the handset.

In the UK some timings considered to be fixed timings cannot be changed by handset. These are typically the Amber and Red/Amber periods. These timings can, however, be specified as alterable at configuration time to suit other signal sequences, Non-UK requirements etc.

Some timings considered to be safety timings can only be changed by a person at the ST750 operating the write enable 'level 3' push button, e.g. minimum green, intergreen, blackout timings, etc.

The default timings for the ST750 standard Pedestrian configurations are given in their IC4 printouts (Special Instructions). These printouts also show the handset commands that are used to change each of the timings. Some of these timings are described in Section 3.

A summary of all the timings available within the ST750 Non-UK intersection controller is contained in the ST900 General Handbook (see Section 1.3 for details). It also shows their upper and lower limit values and, where applicable, the configurable limits.

2.7.1 Tolerance

All timings, except CLF and Master Time Clock, are derived from the crystal frequency which has a tolerance of 35 parts per million. An additional error, due to

random signals not being synchronised to the clock pulse, may add up to 200ms to the time.

If the result of the above timings is required to change the signal lamps, a further error may occur up to a maximum of 21ms.

The set-up accuracy of the real time clock and the accuracy of any offsets calculated from it will be 1 second.

2.8 MASTER TIME CLOCK and CLF SUMMARY

- Master Time Clock
- Timing Sources – 50Hz or 60Hz Mains (automatically detected)
- Standby Timing – On board crystal and battery support programmable up to 31 days. Accuracy of standby crystal oscillator is 35 parts per million.
- Programmable changeover to mains synchronisation.
- Facility for synchronising the real time clock or group timer from existing UTC.
- Number of time switch settings – 64
- Number of time switch functions – 3
 - (a) Isolate controller
 - (b) Introduce a CLF plan
 - (c) Introduce time-switch events such as alternative maximum green periods
- Cableless Link Facility
 - Number of plans: 16
 - Number of plan influence tables: 16
 - Number of groups per plan: 32
 - Number of group influences: 10 types

2.9 MODES OF OPERATION

The following modes are available on the ST750 Pedestrian controller, and are described fully in Section 3:

- Stand Alone Pedestrian V.A.
- Stand Alone Pedestrian V.A. with pre-timed maximum period
- Stand Alone Pedestrian Fixed Vehicle Period
- Stand Alone Pedestrian Cableless Link (Pedestrian inhibit)
- Stand Alone Pedestrian UTC ('PV' control bit)
- Stand Alone Pedestrian Local Link ('PV1' control)

The following intersection modes are available on the ST750 Non-UK controller:

- Start Up
- Part-time (Off period)
- Urban Traffic Control.
- Emergency Vehicle
- Priority (Non-emergency vehicle)
- Hurry Call
- Manual Operation
- Manual Step-On, if fitted.
- VA, CLF or FT Operation (selected via mode switch)
- Cableless Linking
- Vehicle Actuated (VA)
- Fixed Time (FT)

For more information refer to the ST900 Family General Handbook

2.10 Cabinet Characteristics

The ST750 Outer case is a single sided access cabinet with the following dimensions:

Small outer case –

Height	1200mm
Width	466mm
Depth	370mm
Approximate weight of cabinet and stool, including one Gemini, and two Loop Detector cards	47Kg

Large outer case -

Height	1157mm
Width	730mm
Depth	426mm
Approximate weight of cabinet and stool, including one Gemini, and two Loop Detector cards	50Kg

Table 5 – ST750 Cabinet Assembly Size and Weight

For more details on the Small and Large cabinets refer to section 4.1

The case is manufactured in grey or black powder coated aluminium.

In addition to the screw-locks, the main controller door is fitted with a S18 lock. There is a facility to change the S18 lock to a Yale with an RKA27C pattern barrel.

Note

The key lock should not be operated unless the screw locks are tight, i.e. Unlock the case before undoing the screw lock and only lock the case after tightening the screw locks.

The lock used on the Manual Panel is a small Yale lock with a 900 pattern barrel.

2.11 ENVIRONMENTAL

2.11.1 Temperature

The ST750 in a grey outercase is designed to operate in external ambient temperatures of -25°C to $+65^{\circ}\text{C}$.

Its use in countries where high levels of solar radiation are expected with longer periods of exposure may impose power restrictions on the ST750 hardware configuration. Contact Engineering at Poole for more details on hardware restrictions.

2.11.2 Atmospheric

The controller is proofed against driving rain and sand, dust conditions and industrial pollution.

2.11.3 Humidity

The ST750 will withstand a temperature of 45°C with a relative humidity of 95%.

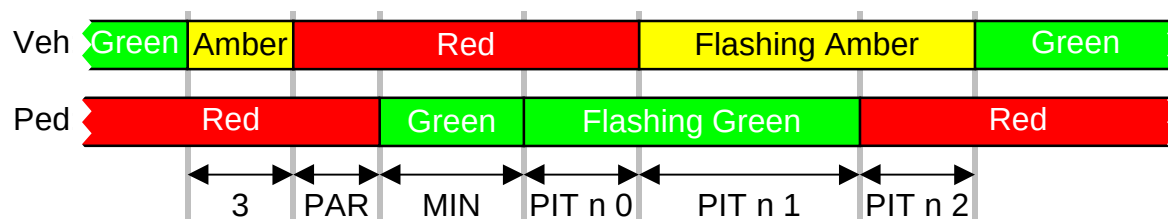
3. PEDESTRIAN FACILITIES

3.1 Types of Pedestrian Crossings

3.1.1 Pelican Crossing

The vehicle to pedestrian intergreen is controlled by the PAR Pedestrian All-Red period. The PAR handset command allows different all-red periods to be executed depending on why the vehicle phase left green. Different times can be specified for each of the following: fixed vehicle period mode (see section 3.2.1), VA mode 'gap' change and VA mode 'max' change (see section 3.2.2), a 'linked' change (see section 3.2.4).

The pedestrian to vehicle intergreen is divided into three fixed periods governed by the PIT Pelican Intergreen Times.



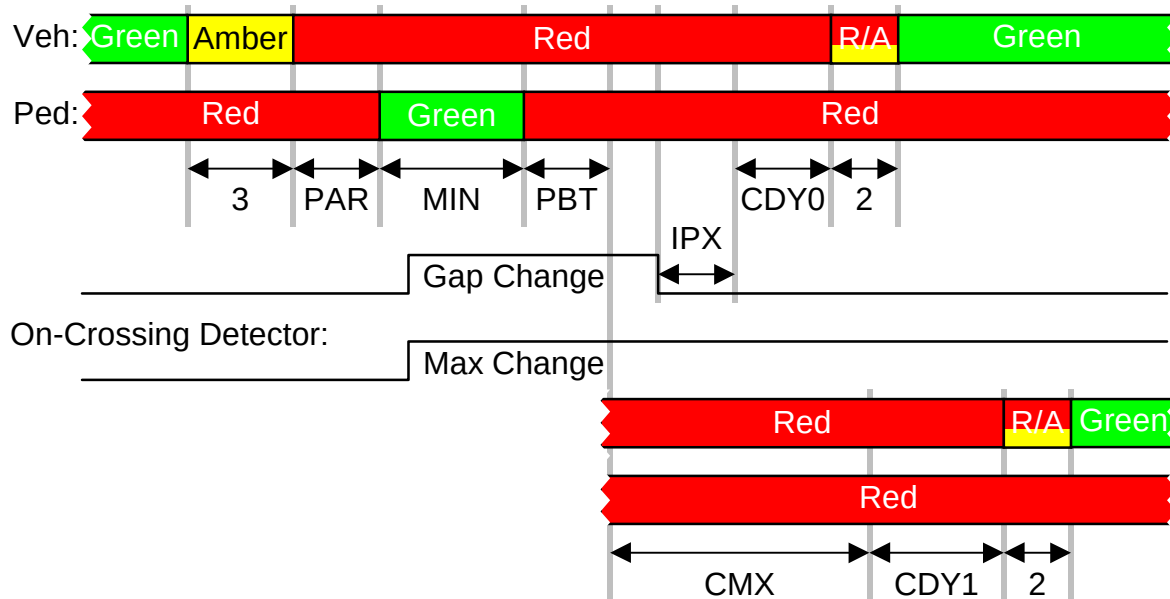
3.1.2 Near Sided Pedestrian Crossing

The vehicle to pedestrian intergreen on a stand-alone crossing is controlled by PAR. However if the near-sided pedestrian phase is part of an intersection stream, then this period is controlled solely by the IGN intergreen command.

The pedestrian to vehicle clearance period consists of:

- a minimum period governed by PBT p,
- an extendable period limited to a maximum governed by CMX p,
- a gap clearance delay CDY p 0, or
- a max clearance delay CDY p 1

where 'p' is the pedestrian phase letter.



On intersections, the appearance of the vehicle phase will be delayed further if the IGN intergreen time is larger than PBT plus the red/amber period.

3.1.3 Far Sided Pedestrian Crossing

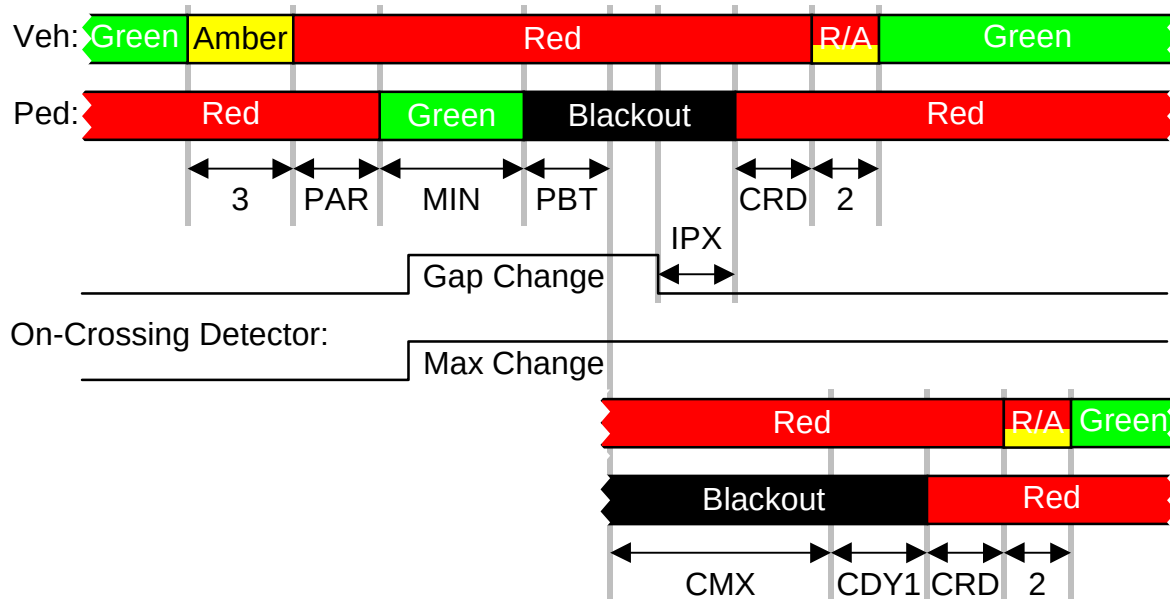
The vehicle to pedestrian intergreen on a stand-alone crossing is controlled by PAR. However if the far-sided pedestrian phase is part of an intersection stream, then this period is controlled solely by the IGN intergreen command.

The pedestrian to vehicle blackout clearance period consists of:

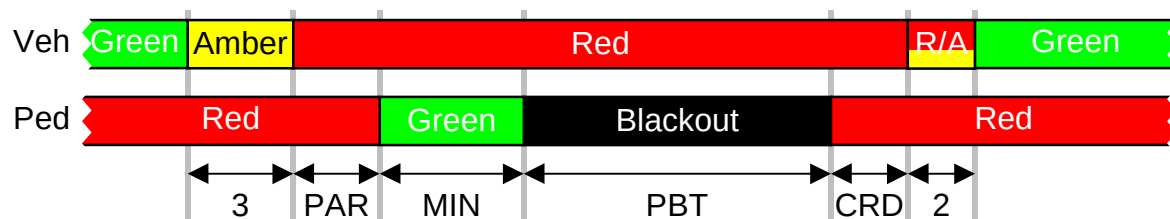
- a minimum period governed by PBT p,
 - an extendable period limited to a maximum governed by CMX p,
 - a gap clearance delay CDY p 0*, or
 - a max clearance delay CDY p 1
- where 'p' is the pedestrian phase letter.

Following this blackout clearance period, there is a clearance all-red period CRD p.

* The gap clearance delay CDY p 0 is usually set to zero and hence is not shown on the following diagram.



If a fixed black-out period is required, i.e. with no on-crossing detectors, then CMX should be set to zero so that the black-out period is controlled solely by PBT:



On intersections, the appearance of the vehicle phase will be delayed further if the IGN intergreen time is larger than PBT plus CRD plus the red/amber period whether CMX is zero or non-zero. But for backwards compatibility, if CMX and CRD are both zero, then the intergreen is controlled solely by IGN even if PBT is set longer.

3.1.4 On-Crossing Detectors

'On-Crossing Detectors' are above ground detectors that are used to determine whether pedestrians are still crossing. While pedestrians are still crossing, the extendable clearance period is extended, up to its configured maximum (CMX in the above diagrams).

The on-crossing detector inputs are configured using IC4 and the extension times are configured on an input basis (i.e. IPX).

If an on-crossing detector is unused, i.e. where several have been configured by default on a stand-alone controller, it can be de-allocated using IOA. If no extendable clearance period is required on a particular phase, then the clearance maximum time (CMX) can be set to zero. If all of the on-crossing detectors for a phase are de-allocated but the clearance maximum time is non-zero, then the clearance period is extended up to its maximum.

Also note that if the Continuous Ped Demand (CPD) button on the manual is pressed, then the red clearance of near-sided signals will be extended to its maximum as required by TR2500A.

If an on-crossing detector has not been activated from the end of the preceding pedestrian clearance period to the end of the current pedestrian steady green period, then the clearance period is forced to run to its maximum.

A fault will not be recorded if this occurs, instead the controller will wait until the normal DFM time-outs confirm and report a fault.

3.2 Pedestrian Modes Of Operation

A stand-alone pedestrian crossing can run any of the following modes of operation:

3.2.1 Fixed Vehicle Period

The vehicle phase appears at green for at least a fixed period. No vehicle detection equipment is required.

If the pedestrian phase is demanded while this period is still running, the vehicle phase remains at green. When the period expires, the vehicle phase loses right of way and the pedestrian phase subsequently appears at green.

If the pedestrian phase is demanded after this fixed vehicle period has expired, then the vehicle phase immediately (subject to the pedestrian demand delay see section 3.3.3) loses right of way and the pedestrian phase subsequently appears at green.

When the pedestrian phase has completed its green period and the controller has executed the required 'pedestrian to vehicle clearance period' (see section 3.1), the vehicle phase returns to green.

The fixed vehicle period is specified by the handset commands MEX, MFX, MGX and MHX allowing four different times to be called up at different times of the week.

3.2.2 Vehicle Actuated

This mode requires vehicle detection equipment, either inductive loops cut into the road's surface or 'above ground' detectors (usually microwave detectors) mounted on the signal poles. Activations on these inputs start (or restart) the 'extension time' for the phase and while this is active, the vehicle phase will (normally) remain at green.

The vehicle phase appears at green for at least a minimum period specified by the MIN handset command.

If the pedestrian phase is demanded while this period is still running, the vehicle phase remains at green until at least this period has expired.

If the pedestrian phase is demanded after this 'minimum' period has expired and no vehicles are present, then the vehicle phase loses right of way immediately.

If the vehicle detectors indicate that vehicles are present, then the vehicle phase will remain at green until the vehicles are no longer present. This is referred to as a 'gap change' since the vehicle phase loses right of way to service the pedestrian demand when a gap in the traffic appears.

However, when the pedestrian phase is demanded, the vehicle phase's 'maximum green timer' is started. If vehicles continue to be present, keeping the vehicle phase at green, the vehicle phase will lose right of way when this timer expires, even if vehicles are still present. This is referred to as a 'max change' since the vehicle phase loses right of way when its maximum green time expires.

The maximum green time is specified by the handset commands MAX, MBX, MCX and MDX allowing four different times to be called up at different times of the week.

When the pedestrian phase has completed its green period and the controller has executed the required 'pedestrian to vehicle clearance period' (see section 3.1), the vehicle phase returns to green.

3.2.3 Vehicle Actuated with Pre-Timed Maximum (PTM)

This mode is very similar to normal vehicle actuated mode, except that the vehicle phase's maximum green timer is started as soon as the vehicle phase appears at green, regardless of whether there is a demand for the pedestrian phase.

The option is enabled using the PTM handset command.

Therefore, if the vehicle phase has already been at green for longer than its configured maximum green time when a push-button is pressed, the vehicle phase loses right of way immediately subject to the pedestrian demand delay (see section 3.3.3) or the pre-timed maximum extra.

Compare this to the normal vehicle actuated mode, where the pedestrian would have to wait for up to the maximum green time (if vehicles continue to be present) before the vehicle phase loses right of way.

3.2.4 Linked Operation

With the controller running any of the above three modes, the operation controller can be further modified by various 'linking' options.

These options hold the vehicle phase at green until a specific time when the pedestrian phase is allowed to appear. During this 'window' vehicle extensions are removed to ensure that any pending demand for the pedestrian phase is serviced.

This is often required, for example, when the pedestrian controller is close to an intersection where it is beneficial to keep the pedestrian controller at vehicle green

during certain stages of the intersection controller to help the traffic entering and/or leaving the nearby intersection.

Cableless Link – Using the controller's Master Time Clock and CLF facilities, the controller can be given one or more 'windows' during the CLF cycle when it is allowed to service the pedestrian demands. For the rest of cycle, the vehicle phase remains at green.

UTC – The 'PV' control bit from the instation holds the vehicle phase at green. When the 'PV' bit is de-activated for a short period, the controller will service any pending demand for the pedestrian phase.

Local Link – The 'PV1' input from an adjacent controller holds the vehicle phase at green. When the 'PV1' bit is de-activated for a short period, the controller will service any pending demand for the pedestrian phase.

3.3 PEDESTRIAN DEMAND CONTROL

3.3.1 Introduction

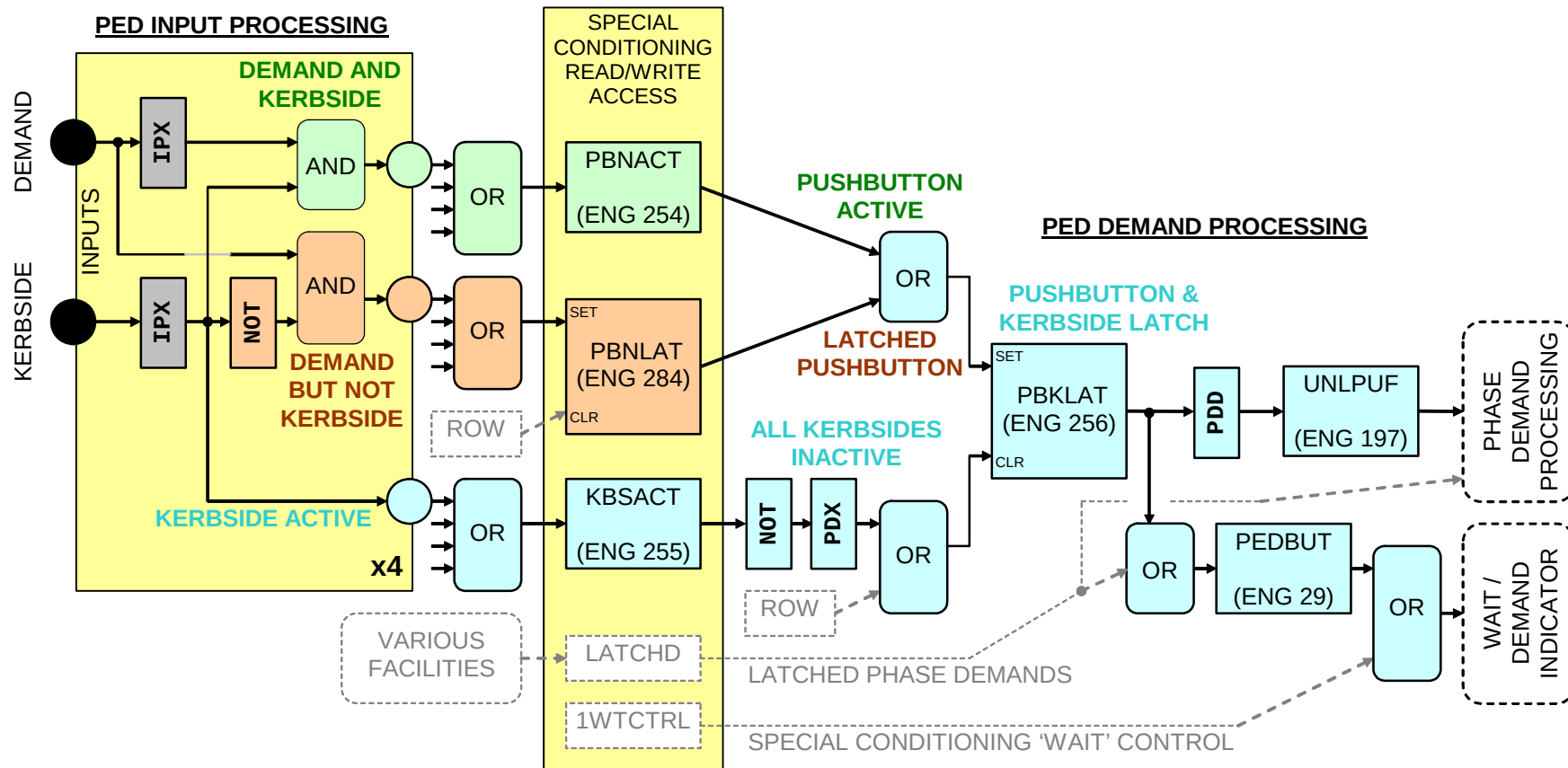
In addition to pedestrian push buttons, the controller can be configured with 'cycle detectors' and 'kerbside detectors'. The controller firmware treats 'cycle detectors' and 'push-button inputs' the same and both should be configured to demand the phase in the usual way.

'Kerbside detectors' allow the controller to cancel the demand (and switch off the wait / demand indicator) if the pedestrian crosses before the pedestrian phase gains right of way..

A push button input can be associated with a specific kerbside input in order to determine the type of pedestrian demand inserted. A kerbside input can be associated with one or more push button inputs, or it can be associated with none in which case it is only used to hold and cancel the demand.

Figure 2 – Ped Demand Processing" overleaf shows the pedestrian demand processing performed by the firmware described in the rest of this section.

Figure 2 – Ped Demand Processing



The following lines can be used in special conditioning to add pedestrian phase demand and kerbside inputs in addition to those provided by the firmware:

```

;xxPB = Pushbutton input, xxKBS = Associated Kerbside input, 'p' = Phase letter
xxPB_ext.xxKBS_ext=+PBNACTp    ;Pushbutton and Kerbside both active
xxPB.NOT(xxKBS_ext)=+PBNLATp    ;Pushbutton active while kerbside inactive
xxKBS_ext=+KBSACTp              ;Kerbside extension active
    
```

3.3.2 Pedestrian Demand Acceptance

For the purposes of this section, push button inputs include any demand inputs assigned to a pedestrian phase, including for example inductive loops for cycles.

If no kerbside detectors are configured on the phase, pressing the push buttons generates a latched demand for the pedestrian phase, which is only cleared when the pedestrian phase gains right of way.

If kerbside detectors are configured on the phase, then the operation is as follows:

Every push button input and every kerbside input is configured with its own extension period (which can be modified using the IPX handset command). The extension remains active for the configured period after the input goes inactive.

An **unlatched demand** for the pedestrian phase is accepted and the wait / demand accepted indicator illuminated when a push button (or its extension) and its associated kerbside detector (or its extension) are both active at the same time. This demand will be cancelled when all the kerbside inputs go inactive.

A **latched demand** for the pedestrian phase is accepted and the wait / demand accepted indicator illuminated when a push button input is active but its associated kerbside detector (and its extension) is inactive, or no kerbside detector has been associated with that push button input. This demand is only cleared when the phase gains right of way.

3.3.3 Pedestrian Demand Delay (PDD)

The transition from vehicle green to pedestrian green starts with the vehicle changing to amber. A delay before starting this transition can be configured so that the vehicle phase does not terminate as soon as the pedestrian push button is pressed, although the wait indicator is illuminated.

The delay is controlled using the handset command PDD.

The controller uses the following rules:

- In VA mode, if one or more real phases are at right of way (and none of the phases at right of way have pre-timed maximums configured) the delay is not applied, since if vehicles are present, their extensions will keep the vehicle phase at green.
- In VA mode, the controller will examine the maximum green timers of all conflicting phases which are at right of way which have also been configured to run a 'pre-timed maximum' but no 'pre-timed extra period' (see PTM and PTX in section 3.2.3). If any have expired or have less time to run than the delay, the delay is introduced, otherwise all have more time to run than the delay, so no delay is introduced and the controller will only allow the stage change if none of the phases are being extended.

- In VA mode, if no real phases in the same stream are at right of way, the delay is introduced, so delaying the appearance of the pedestrian green after a quiescent all-red period, for example.
- In all other modes, the delay will always be introduced. This is to cater for cases such as 'fixed vehicle period' mode, UTC inserting a demand dependant force for the pedestrian phase, or CLF introducing a demand dependant move just after the push-button is pressed. Introducing the delay prevents these cases making a stage move shortly after the push-button is pressed. In most other cases, the demand delay will have little or no effect.

Note that special conditioning can always be written to 'short-circuit' the pedestrian demand delay if required under certain circumstances by putting in an unlatched demand for the phase if the wait indicator is lit.

3.3.4 Pedestrian Demand Cancel (PDX)

The unlatched phase demand is cleared when all kerbside detectors and their extensions for the phase have been inactive for the configured pedestrian demand extension time for the phase (PDX). The wait / demand accepted indicator will be extinguished if there are no other demands present for the phase.

Note that the phase may still appear at green if the controller has already started the move to the stage in which the phase appears.

3.3.5 Kerbside Detector (Mat) Testing

Kerbside detector testing can be performed by the firmware to check the operation of kerbside 'mat' detectors.

Every 60 seconds, if there are no pedestrian phase demands active and no push-button (or cycle) inputs active, the controller outputs a 500ms (± 50 ms) test pulse on a configured output. If the output is de-allocated using IOA, no kerbside testing will be performed.

This output is connected to all the kerbside detectors and should result in all of the kerbside inputs going active during the pulse.

Therefore, the test is not performed while a pedestrian demand exists since this will extend the pedestrian demand if the kerbside input has just gone inactive and the controller is timing off the kerbside and demand extension periods.

Nor is the test performed while any push-button or cycle inputs (or their extensions) are active since the kerbside test will activate the kerbside inputs even though no-one may be present and allow these inputs to produce a demand for the pedestrian phase.

Each configured kerbside detector is sampled twice and if either sample on a particular kerbside detector indicates the detector is inactive*, the detector is logged as faulty, the DFM indicator is illuminated and the detector input forced active (regardless of the setting of the DFM forcing action command 'DFA').

* Note that for the input to be seen inactive at the 200ms processing rate, all ten 20ms samples must have been inactive.

Thereafter, the force is only removed after 5 consecutive tests of the detector have passed, but the fault log entry remains set and the DFM indicator remains illuminated, until RFL=1 is entered.

If the maintenance engineer enters RFL=1, the controller will automatically perform a test. If a kerbside detector which was reported as faulty passes this test, even if this is the first test that it has passed, the fault log entry for that detector is cleared and the detector is assumed to be working. This means that when the maintenance engineer fixes a kerbside detector, they do not have to wait for 5 automatic tests before they can clear the fault, they just need to enter RFL=1.

4. HARDWARE OVERVIEW

4.1 Cabinet Options

The ST750 is available in either the T400S (small) or ST900 (Large) cabinet / Outer Case

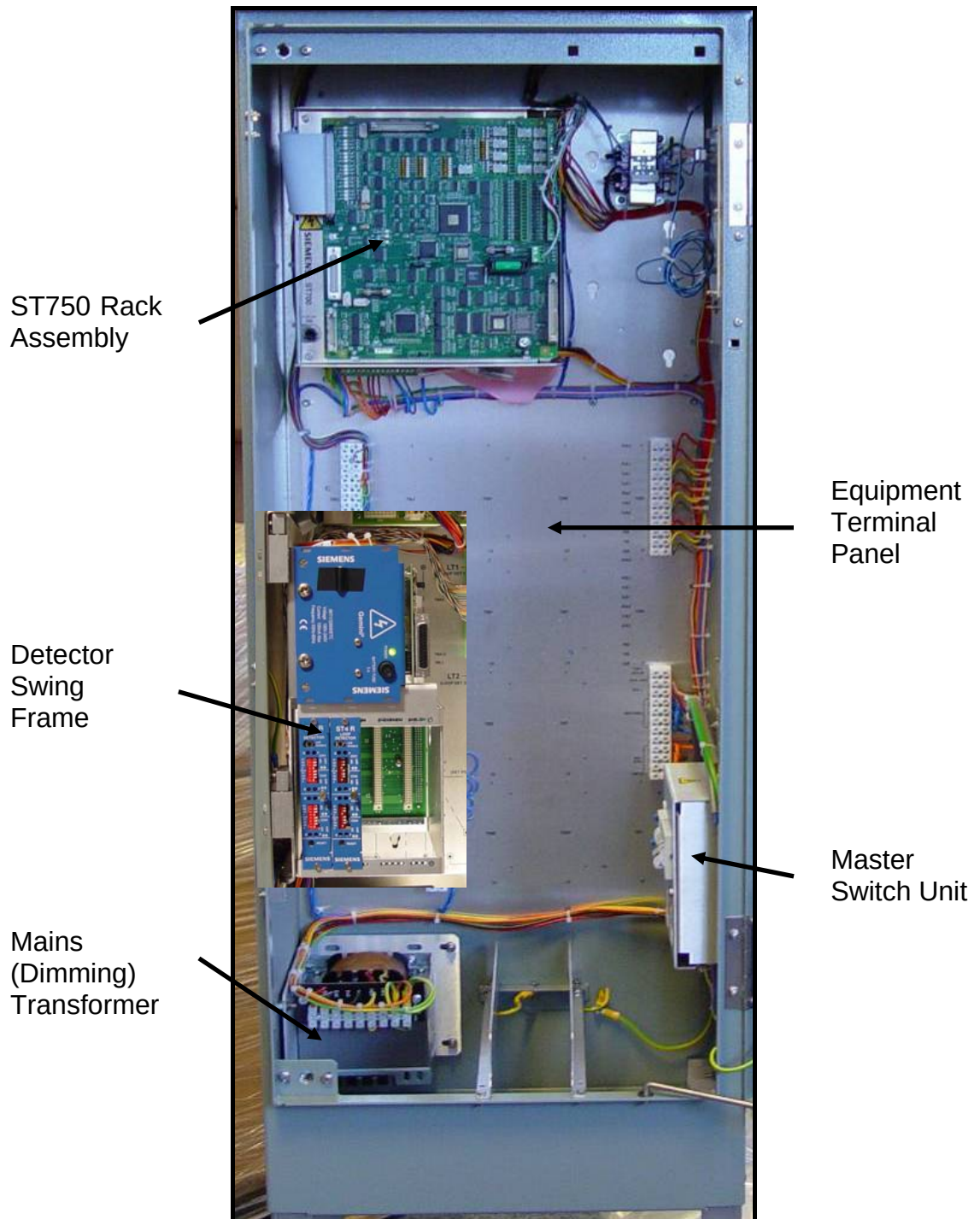


Figure 3 – ST750 in Small Outer Case with Detector Swing Frame

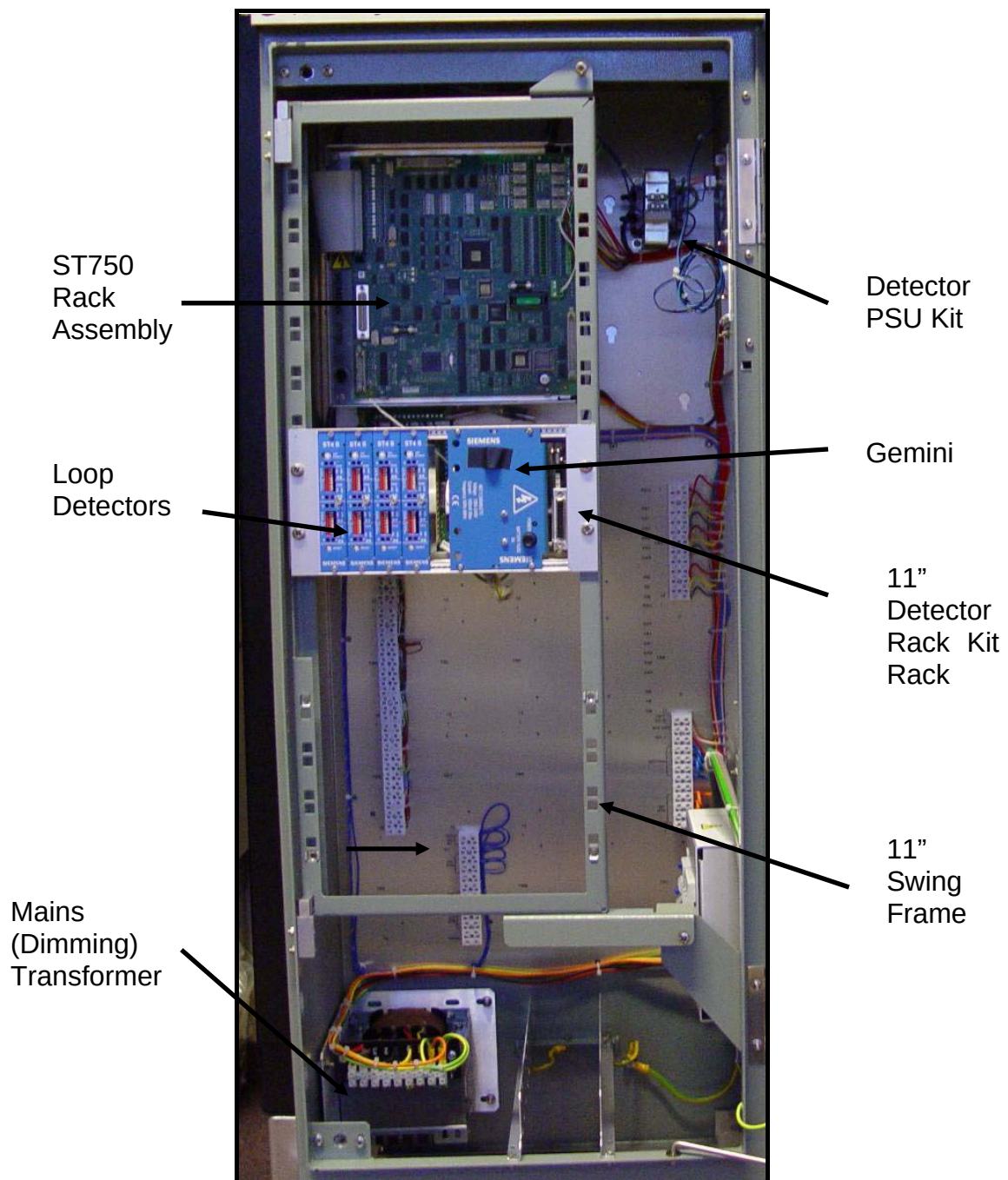


Figure 4 – ST750 in Small Outer Case configured with optional 11" Swing Frame

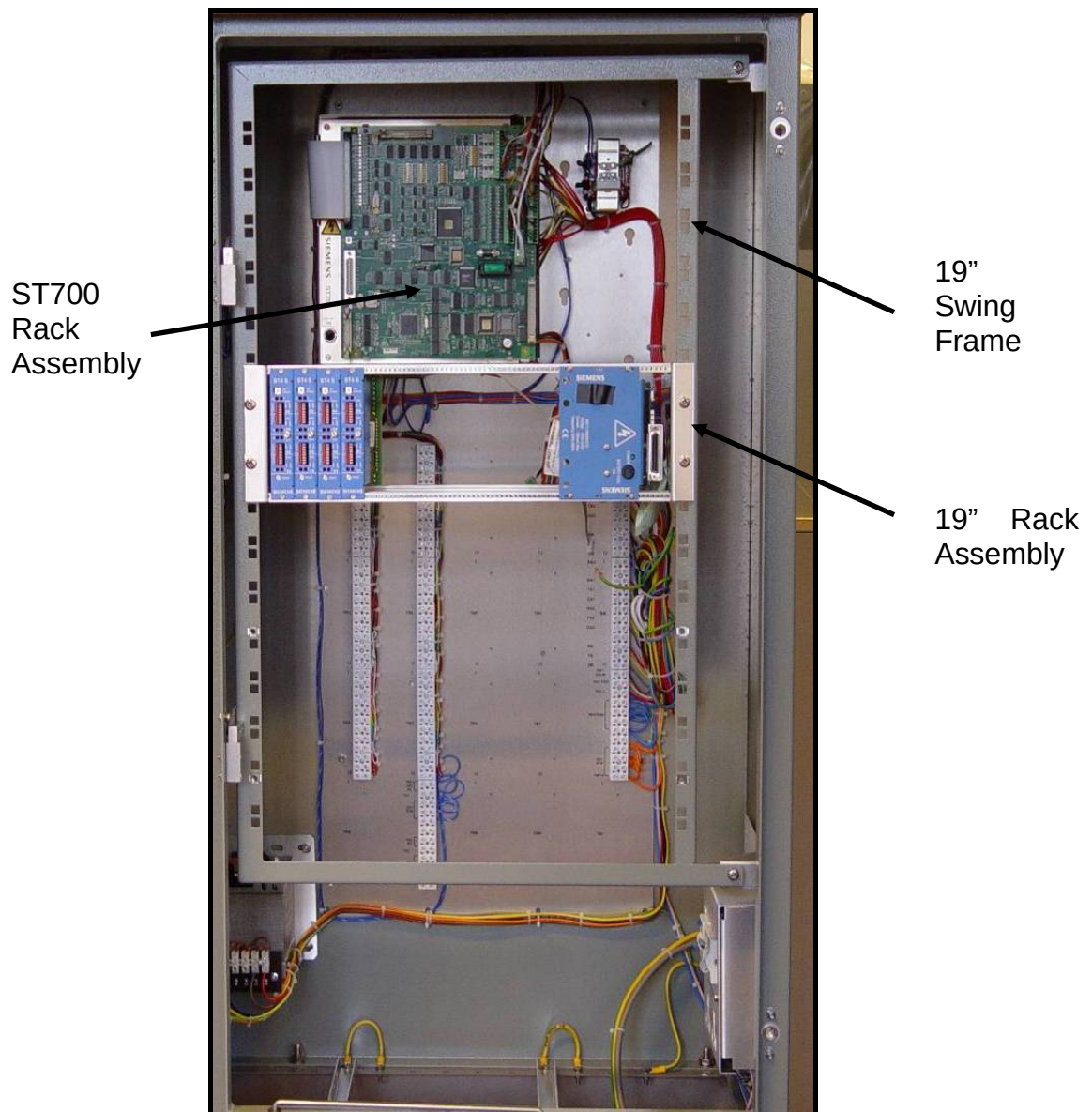


Figure 5 – ST750 in Large Outer Case configured with optional 19" Swing Frame

4.2 The ST750 Rack Assembly

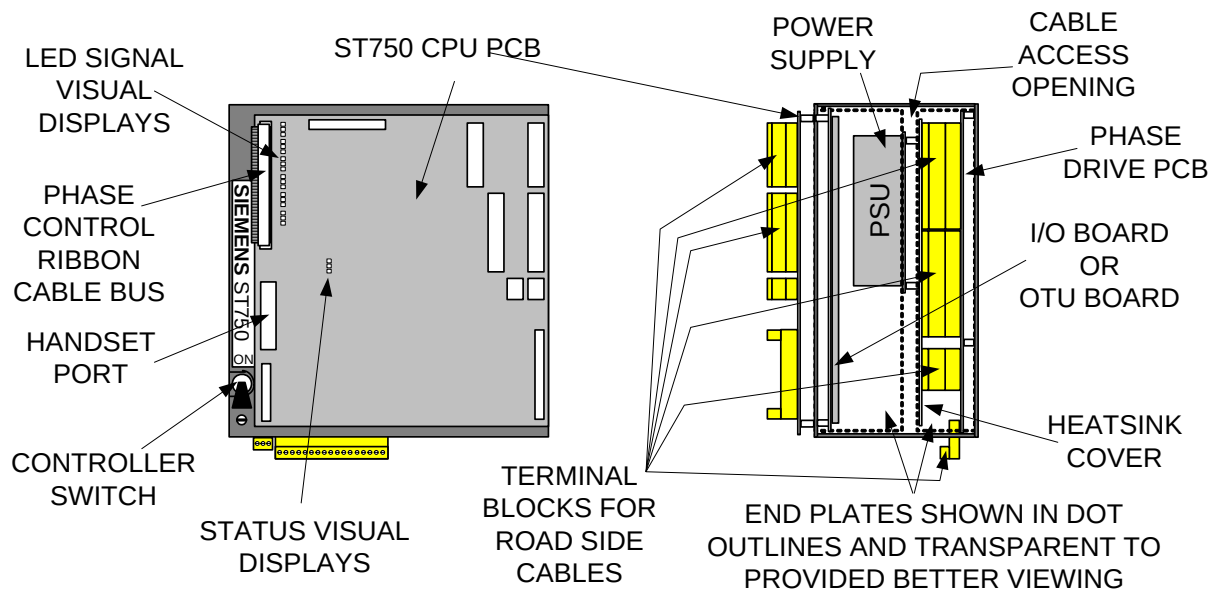


Figure 6 – ST750 Rack Assembly

The ST750 Rack Assembly consists of a box like frame with a plate hinge on the front that acts as an access door.

The Phase Drive PCB is mounted behind the ST750 CPU PCB in this assembly. This contains the logic power supply, the mains distribution, Solid State Relay, A Relay, B Relay, Dimming relays, the mains fusing, and the Phase Drives, along with the terminal blocks to wire the phase drives directly to the road side cables. The Phase Drive PCB has a flying 64-way Phase Control Bus ribbon cable attached. This connects to the ST750 CPU PCB and supplies the power and control signal to that card.

Mounted on the heatsink cover of the Phase Drive PCB is the mains power supply unit (24V DC output) that is mains powered from, and supplies 24Volts to, the Phase Drive PCB via a cableform.

The ST750 CPU PCB is mounted on the outside of the hinged plate. This contains the Dual Processors and associated logic, LED signals and status visual display, Handset Port, Modem Port, Manual Panel Port and I/O circuits along with the terminal blocks to wire the I/O circuits directly to the road side cables.

This leaves space on the inside of the hinged plate to mount an additional I/O PCB or OTU PCB as and when required. These cards are the same as those used on the ST800 and thus are connected to the ST750 CPU PCB using an extended system bus cable that runs along the side.

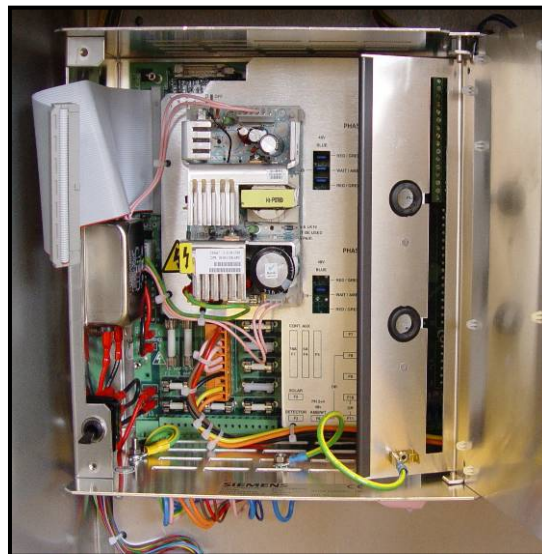
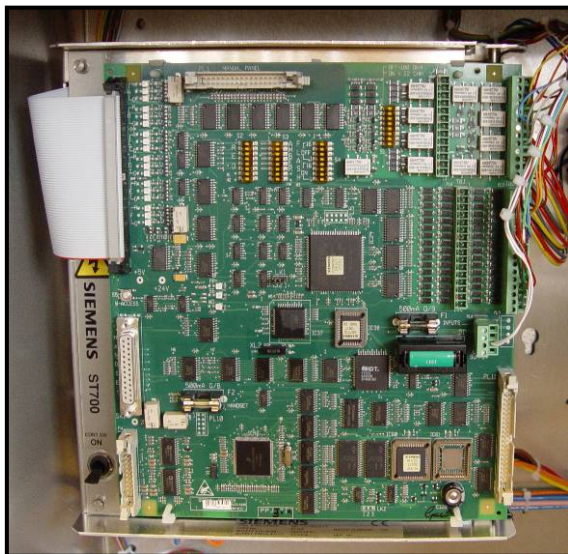
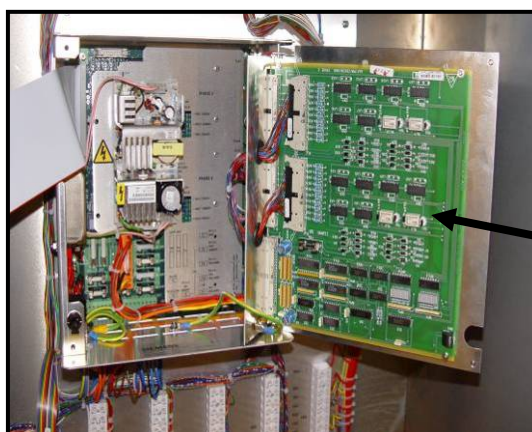


Figure 7 – CPU and Phase Driver Cards



I/O
Expansion
Card

Figure 8 – I.O Expansion Card

4.3 ST750 CPU LEDs

There are 21 LED indicators on the component side of the ST750 CPU PCB in two groups, Status (see section 4.3.1) and Signal (see section 4.3.2), as shown in Figure 9.

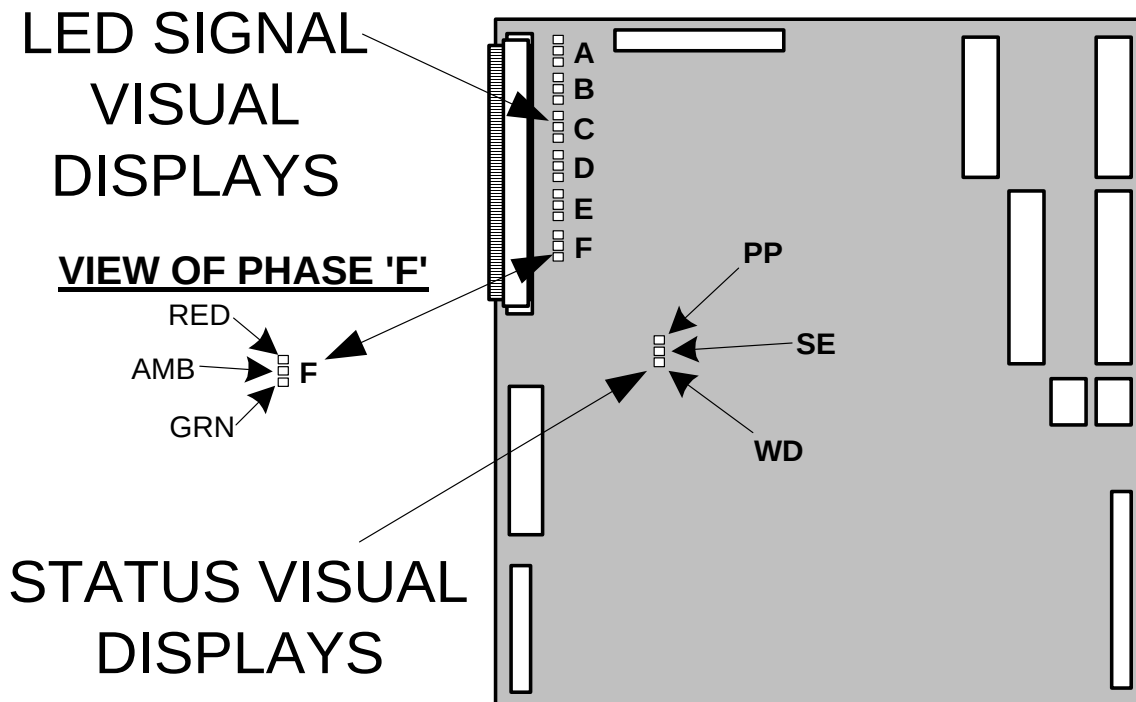


Figure 9 - CPU LEDs

4.3.1 Status LED Group

The top Status LED is green and is labelled 'PP' for power present. This LED flashes giving a heartbeat indication that the ST750 is running normally.

If it does not illuminate there is no power to the CPU PCB. Check that the ST750 is powered and that the Phase Control ribbon cable is inserted into the socket of the CPU PCB.

The other two LEDs are red and identify various fault conditions.

The top red LED is labelled 'SE' for system error. This illuminates during the power-up sequence and then extinguishes when the ST750 is running normally with no faults present in its fault log.

The bottom red LED is labelled 'WD' for watchdog. This LED is illuminated when the hardware watchdog circuit times-out. Note that when the firmware detects a serious fault, it extinguishes the signals and deliberately stops 'kicking' the hardware watchdog so that it times-out and reinforces the signals' Off or Fail Flashing condition.

4.3.2 Signal LED Group

These LEDs are in groups of three, one for each traffic phase A to F. Each group has a red at the top, amber in the middle and green at the bottom (see View of Phase 'F' in Figure 9) to represent a set of traffic lights. They provide visual representation of the state of the red, amber and green drives for their respective phase.

4.4 Master Switch Assembly

The Master Switch Assembly is mounted in the bottom right hand corner of the controller, refer to Figure 3

With reference to Figure 10 the mains supply voltage is applied to the main ON/OFF 63A circuit breaker, within the Master Switch Assembly, for onward supply to the ST750 Traffic Controller.

The live supply wire is taken from the main ON/OFF mini circuit breaker and applied to a Master 20A Mini Circuit Breaker.

The output from the 20A Mini Circuit Breaker is applied a 5A fuse. Output from the fuse is applied to 300mA Residual Current Device (RCD) for onwards distribution to the two main outlet sockets. Space is provided on the Master Switch Assembly to fit an additional 5A fuse; to be utilised as an auxiliary power supply. Controller mains power Live is taken from the 20A Mini Circuit Breaker and applied to PL1 on the Phase Drive PCB.

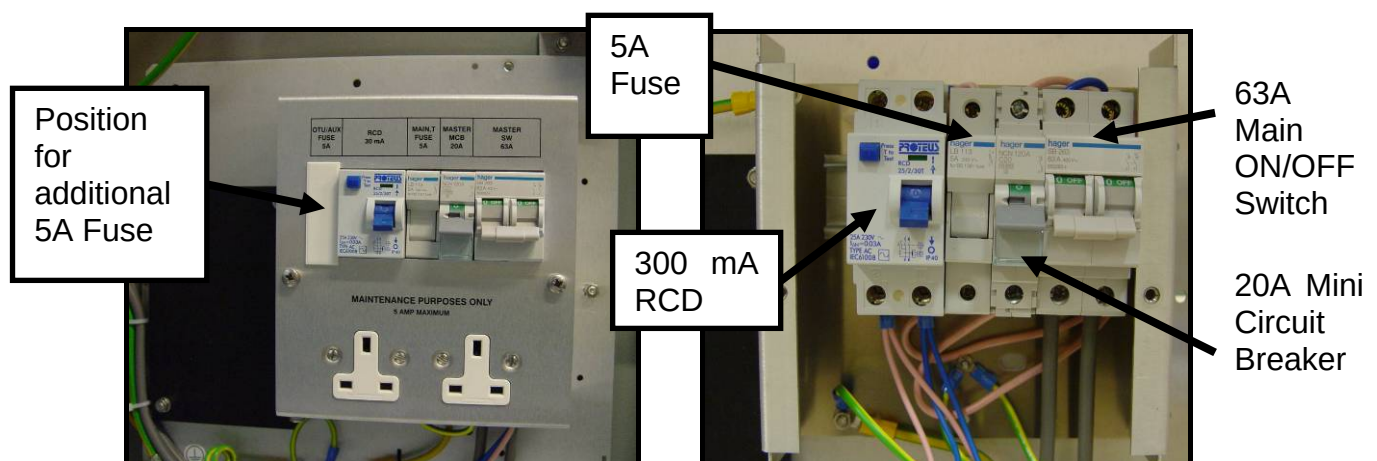


Figure 10 – Master Switch Assembly

4.5 FUSES

Figure 42 on page 111 lists the types and placing of fuses in the ST750. Fuses should only be replaced by ones of a similar rating and type.

4.6 Mains Dimming Transformer

Mains Dimming Voltages are derived from the Mains Dimming Transformer, mounted in the bottom left hand corner of the controller, and delivered to SK1 on the Phase Driver PCB. Please refer to Figure 11.

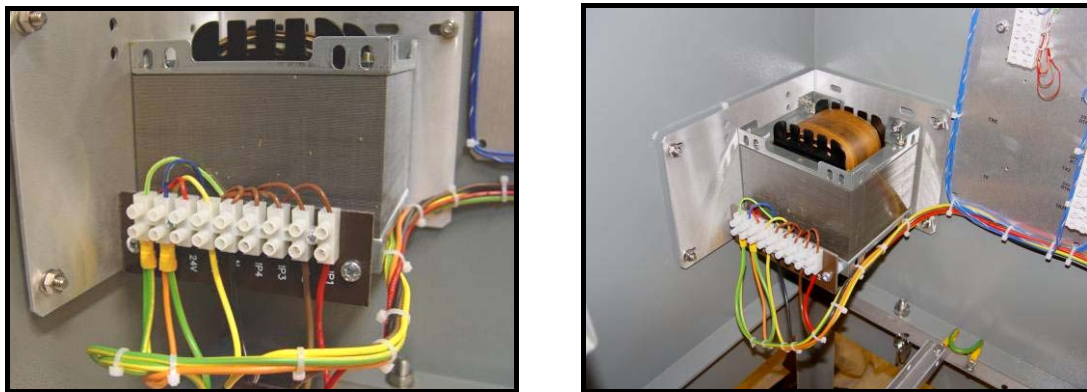


Figure 11 – Mains Dimming Transformer

4.7 Manual Panel

The Manual Panel is situated on the right hand side of both large and small Outer Cases. It is mounted within a secure enclosure, please refer to Figure 12. When the full Manual Panel is not fitted a signals on/off switch is fitted instead.



Figure 12 – Manual Panel (full panel shown)

4.8 Detector Mounting

The ST750 supports Single Detector Back Planes only - the Intelligent Detector Backplane as fitted to ST750 ELV / ST900 / ST900 ELV controllers is NOT supported. For full details on the connection of detectors and power requirements please refer to ST4R/ST4S Detector Manual 667/HB/27663/000.

Single Detector
Backplane Kits
(rear view)

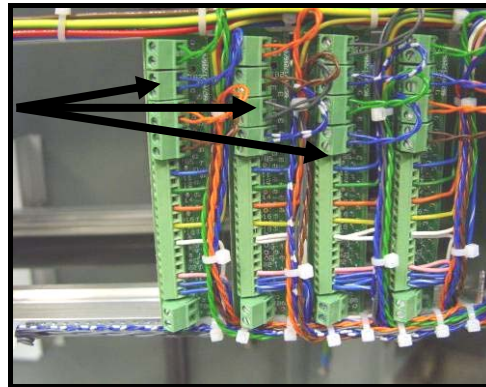


Figure 13 – Single Detector Backplanes

4.8.1 Detector Back plane in Small Outer Case

The ST750 small outer case can accommodate one of two different swing frame configurations – **Note that both swing frames CANNOT be fitted at the same time.**

If four or less Detector PCBs are required, sufficient room is available in a Detector Swing Frame.

The lower portion of the Detector Swing Frame accommodates the Single Detector Backplanes and Detector PCBs, while a Gemini² unit can be mounted on the upper portion of the Detector Swing Frame.

Figure 14 shows the Detector Swing Frame with, Detectors and Gemini² Unit fitted.

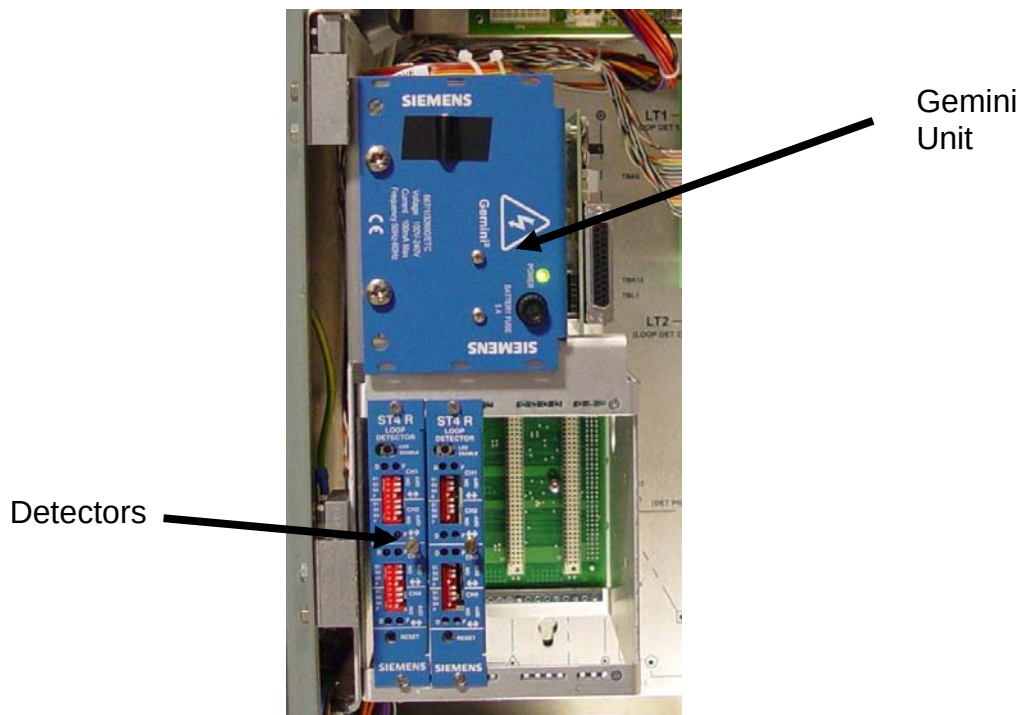


Figure 14 – Detector Swing Frame

Note

The Detector swing frame supported in the ST750 is a different part (667/1/33770/000) to that supported in the ST700.

The detector mounting frame 667/1/27854, as used in the ST700 is NOT supported in the ST750

If more than four Detector PCBs are required, an 11" Swing Frame will be required in the cabinet. With the 11" swing frame fitted, the ST750 can support up to a maximum of eight Detector PCBs and associated Backplanes. With reference to Figure 15, the 11" Swing Frame must be provided with at least one 11" Detector Rack Kit. In this case the Gemini unit (if required) is also mounted in the Detector Rack Kit.

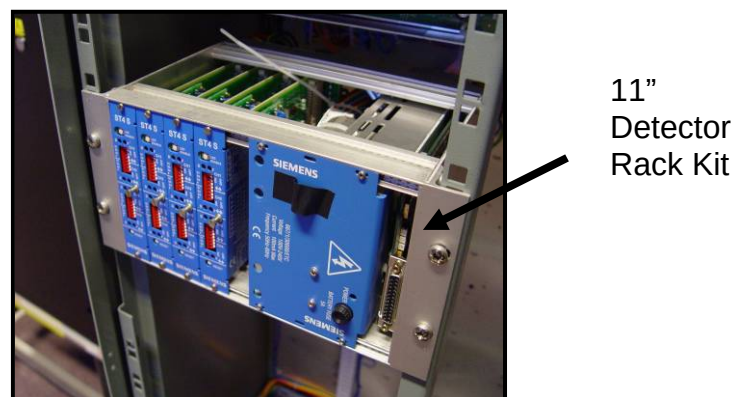


Figure 15 – Detectors in 11" Swing Frame

4.8.2 Detector Back Planes in Large Outer Case

With reference to Figure 16, when a Large Outer Case is used a 19" Swing Frame is required.

One or more 19" Detector Rack Kits should be specified and mounted to the 19" Swing Frame, which in turn provides the platform to mount the Detector Back Planes.

The maximum number of Detector PCBs, which can be specified, is eight. Figure 16 shows the mounting position for the 19" Detector Rack Kit. Power for the Detector PCBs is provided by the Detector Supply Kit.

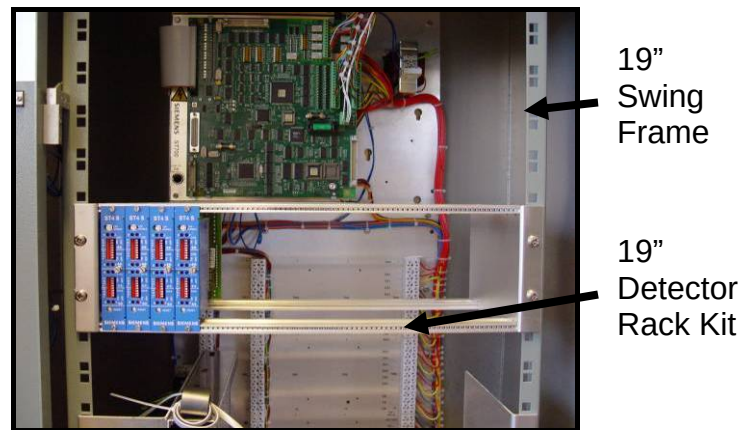


Figure 16 – Detectors in a 19" Swing Frame

4.9 2A Detector Supply Kit

With reference to Figure 17, the ST750 is configured with one detector supply kit, fitted on the right hand side of the ST750 Rack Assembly, as standard.

An additional Detector Supply kit can be specified and fitted immediately below the first. The Detector PSU transformer will be configured with conventional main leads to allow mains supply to be obtained from socket 1 on the Phase Driver PCB.

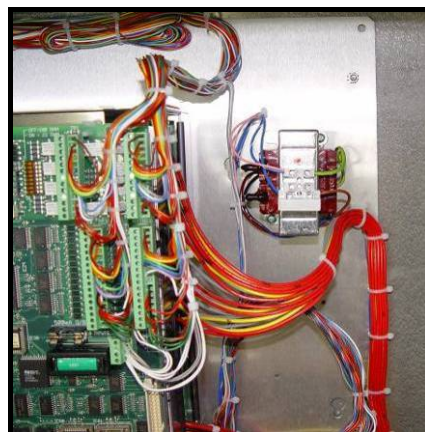


Figure 17 - 2A Detector Supply Kit

4.10 Gemini²

4.10.1 Gemini² in Small Outer Case

When a Gemini² unit is required, it can be positioned in one of two locations, depending on the quantity of Detector PCBs fitted. If four or less Detector PCBs are required then the Gemini² unit can be accommodated in a Detector Swing Frame, refer to Figure 18.



Figure 18 - Gemini in a Detector Swing Frame

Warning!

When fitting a Gemini² in the ST750 Detector Mounting Bracket Assembly care must be taken to ensure that the internal lead acid battery terminals point UPWARDS to prevent leakage. This will require the battery to be re-moved and re-fitted BEFORE installation as when supplied from the factory the battery will be fitted in the opposite orientation. Refer to 667/HB/32600/000 for full details.

Note

The Detector swing frame supported in the ST750 is a different part (667/1/33770/000) to that supported in the ST700.

The detector mounting frame 667/1/27854, as used in the ST700 is NOT supported in the ST750

If more than four Detector PCBs are required then an 11" Swing Frames will have to be fitted to accommodate the Detector PCBs along with the Gemini². Refer to Figure 19.



Figure 19 - Gemini in an 11" Swing Frame

Warning!

When fitting a Gemini² unit in a swing frame care must be taken to ensure that the internal lead acid battery terminals point UPWARDS to prevent leakage. With a Gemini² orientated as In Figure 19 it will be necessary to invert the battery BEFORE installation. Refer to 667/HB/32600/000 for full details.

4.10.2 Gemini in Large Outer Case

The Large Outer Case requires the fitting of a 19" Swing Frame. With reference to Figure 20, the Gemini unit and any detectors should be mounted in the 19" Rack Assembly.

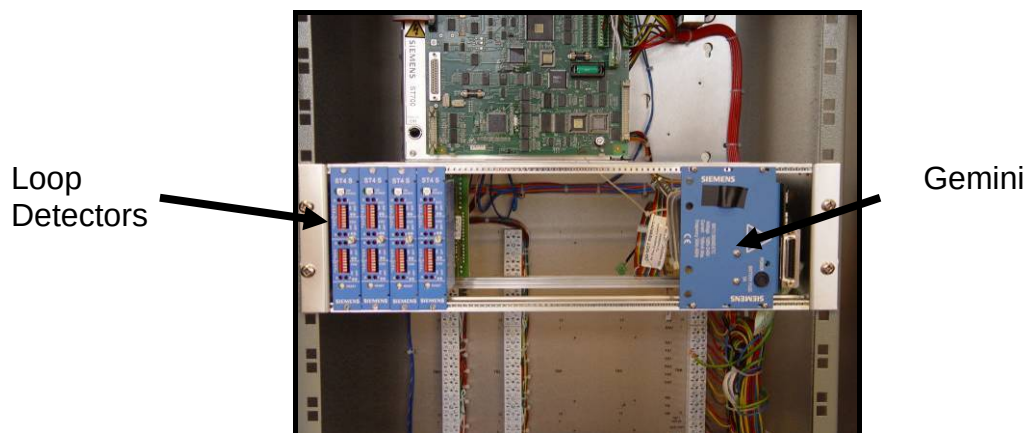


Figure 20 - Gemini in a Large Outer Case

Warning!

When fitting a Gemini² unit in a swing frame care must be taken to ensure that the internal lead acid battery terminals point UPWARDS to prevent leakage. With a Gemini² orientated as In Figure 20 it will be necessary to invert the battery BEFORE installation. Refer to 667/HB/32600/000 for full details.

4.11 TC12 OTU

The Outstation Transmission Unit (OTU) based around the Tele 12 (TC12) Command System, is available in two configurations –

- Integral OTU
- Freestanding OTU

4.11.1 Integral TC12 OTU in Small or Large Outer Cases

The Integral Tele 12 OTU PCB occupies the same position as the I/O Expansion PCB in the Rack Assembly (refer to Figure 8). Therefore, both Integral OTU and I/O Expansion units cannot be fitted in the same controller.

Power to the Integral OTU is obtained via the processor data communication ribbon cable.

For full connections details refer to the Tele 12 General Handbook 667/HB/43100/000.

4.11.2 Free Standing TC12 OTU in Small Outer Case

The freestanding OTU must be specified in a 5U 11" rack unit.

With reference to Figure 21, the 5U Rack is mounted at the bottom of an 11" Swing Frame.

Mains Power to the Freestanding OTU is obtained from the Master Switch Unit.

For full connections and configuration details for the Tele 12 OTU connection scheme refer to the Tele 12 General Handbook 667/HB/43100/000.



Freestanding
OTU in 11"
Swing Frame

Figure 21 - Freestanding TC12 OTU in Small Outer Case

4.11.3 Freestanding TC12 OTU in a Large Outer Case

A freestanding OTU must be specified in a 5U 19" rack unit..

With reference to Figure 22, the 5U Rack is mounted at the bottom of the 19" Swing Frame. Mains

Power to the Freestanding OTU is obtained from the Master Switch Unit.

For connections and configuration details for the TC12 OTU connection scheme refer to the TC12 General Handbook 667/HB/43100/000.

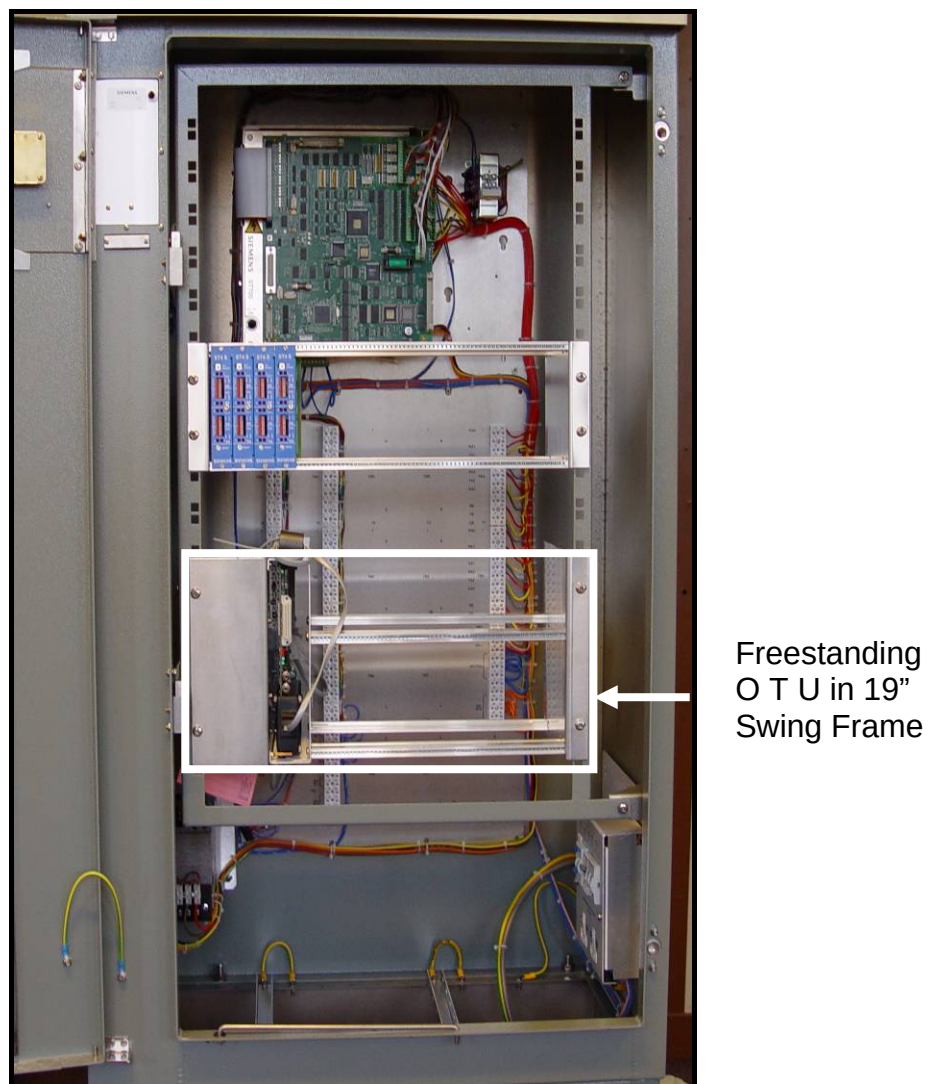


Figure 22 - Free Standing TC12 OTU in Large Outer Case

4.12 SDE/SA

The ST750 does not support the SDE/SA PCB. Instead, the functionality associated with Speed Discrimination and Speed Assessment is contained within the standard ST750 controller firmware. Please refer to the doc 667/HH/32900/00 for the appropriate handset commands.

5. INSTALLATION AND COMMISSIONING

This section details the procedure for installing and commissioning of the ST750 pedestrian controller in both the small and large controller cabinet arrangements.

Refer to section 6 for instructions on installing and commissioning of the ST750 Rack Assembly into other traffic controller cabinets.

5.1 Pre-installation checks

The following checks should be carried out at the service centre and again on site, with the exception of the pre-installation self-test which can only be carried out at the service centre.

The controller cabinet should be visually inspected to check for any damage that may have occurred in transit. Check the security of all internal wiring, PCBs/boards, racks and fixings.

5.1.1 Hardware check

Check against the Works Specification that:

- the correct boards and kits (including the Firmware PROMs and PLD) have been supplied and fitted correctly.
- the appropriate links have been made on all the PCBs/boards.
- all fuses are fitted and are of the correct ratings.
- the correct interconnection cabling has been installed within the controller cabinet, e.g. Detectors to Rack Assembly, OTU to Rack Assembly, etc.
- The dimming transformer taps are set for the required dimming voltage as described in section 5.1.2.

5.1.2 Dimming Transformer Tap Setting

Connect the brown wire, as shown in Figure 23, to the connector block position as per this table:

Required Dimming voltage	Input Tap
160V	IP2
140V	IP3
120V	IP4

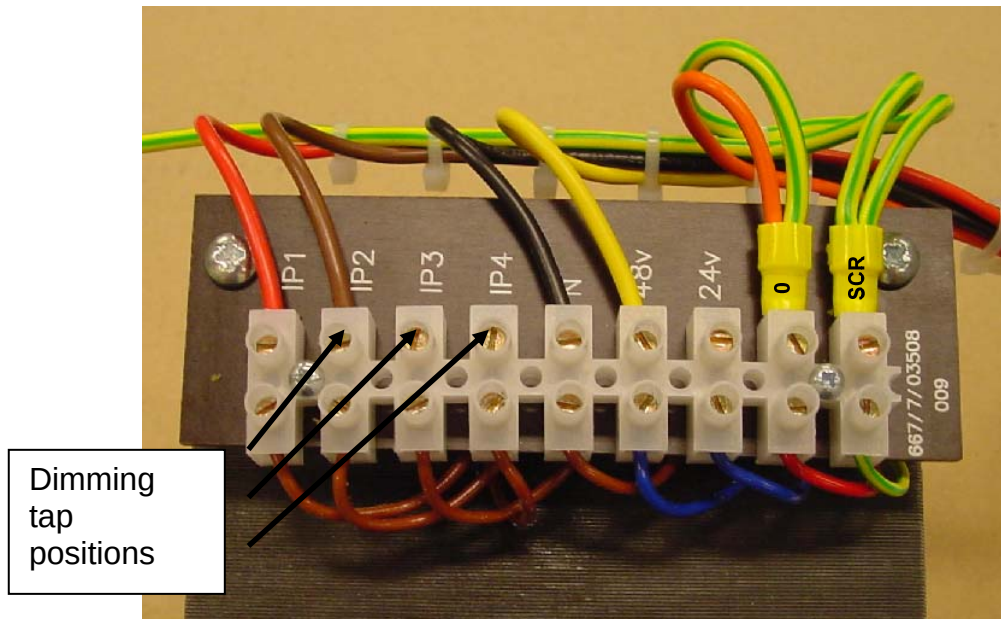


Figure 23 - Dimming Transformer Tap Selection

Once the hardware has been checked as above, it is recommended that a self-test is run (see section 5.16) before leaving the service centre.

5.2 ST750 Cabinet preparation

The controller cabinets are normally delivered from the manufacturing department in a fully assembled and tested state. However to aid installation, the internal equipment has been designed to be readily removable. All of the electronics should be removed from the cabinet if:

- the controller cabinet cannot be made waterproof
- the controller cabinet is un-powered and will suffer from condensation, moisture ingress and animal/insect infestation.
- there is a risk of the equipment being damaged by the contractor.
- the controller cabinet will be left un-powered for a prolonged period.

5.3 Site suitability

The ST750 controller cabinet is installed to suit local conditions, but subject to the following limitations:

- (i) The position of the controller cabinet is as shown on the relevant site plan, STS.
- (ii) No part of the Cabinet is less than 457mm (18 inches) from the kerbside unless agreed with the customer.

When it is necessary to site the controller cabinet less than 2 metres from the outer edge of the kerb, the access panels should not open toward the

carriageway. Where no pedestrian guard rails are fitted, a clearance of at least 600mm should be left between the cabinet and the kerb edge so that guard rails may be installed at a later date without the need to disturb the cabinet installation.

- (iii) Any person having control over the junction, whether manual control or test box simulation, MUST have a good view of the intersection.
- (iv) When the ST750 controller cabinet is to be located on unmade ground (e.g. a grass verge) it is recommended that paving slabs or a concrete standing be provided at ground level on the manual panel (left) side and the front side. The hard standing shall extend a minimum distance of 900mm away from the door, extending the full width of the controller cabinet, and at least 800mm away from the side of the cabinet with a flap, again extending the full width of that side. Customers may specify particular requirements.

5.4 Installation of the ST750 Small Cabinet

The following list details the order in which it is recommended that an ST750 installation take place in the ST750 small case, generally known as the ST400S case.

Warning!

It should be noted that the ST750S case is not designed to have the controller stool removed. If the two parts are separated the stool will flex and once concreted in the ground it may NOT be possible to refit the controller cabinet to the stool or it may result in the case becoming distorted.

The following list details the order in which it is recommended that an ST750 installation take place.

- the controller cabinet cannot be made waterproof
- Remove the Rack assembly if necessary – section 5.2
- Install the stool and controller cabinet into the ground – section 5.4.1
- Pull the cables into position – section 5.6
- Terminate the armour to the CET connectors – section 5.6
- Fit the CET glands to the CET bars – section 5.6
- Test the cables – section 5.7
- In-fill with kiln dried sand the controller stool/cabinet base and seal the cabinet base – section 5.9 and 5.10
- Refit the Rack Assembly if applicable – section 5.2
- Terminate the cables – Section 5.6

Occasionally it may be necessary to terminate the cable prior to sealing the base. In the case of the ST750 this will result in the necessity of installing the Rack Assembly into the controller cabinet. It is usually better to seal the base and make provision for the installation of additional cables such as Telecom or fibre cable by installing a suitable size flexible duct. This duct itself may then be sealed with expanding foam sealant.

5.4.1 Install Controller Cabinet and Stool

A hole should be excavated and a flagstone at least 600mm x 450mm embedded securely at the bottom of the hole. Refer to Figure 24 for the general method of installation and dimensions. Care should be taken to ensure the correct orientation of the controller cabinet. Care must be taken that the controller and stool are not buried too deep as the controller isolation transformer in this cabinet is very low. Burying the controller too deep will result in a seal below ground level or excessively close to the MDU and the isolation transformer.

If the ST750 controller cabinet is being installed on a slope, allowance must be made for ground level clearance of the door to the uphill side.

The stool is placed in the centre of the flagstone with the bottom edge of the controller cabinet base between 10 and 20 mm below the final ground level as shown in Figure 30. Adjustment may be required to ensure that the top of the stool is horizontal; this should be checked using a spirit level.

Mix up a stiff mixture of concrete (mix: 1 cement, 3 sand, 4 coarse aggregate (20mm) with no excess water) and cover the flagstone to a height approximately 100mm (4") above the bottom of the stool. The concrete must be sloped to provide a run up for the cables. Any cables that already enter the pit must be held away from the wet concrete. Where there is a risk of freezing, a suitable antifreeze additive should be incorporated in the concrete mix to ensure proper curing.

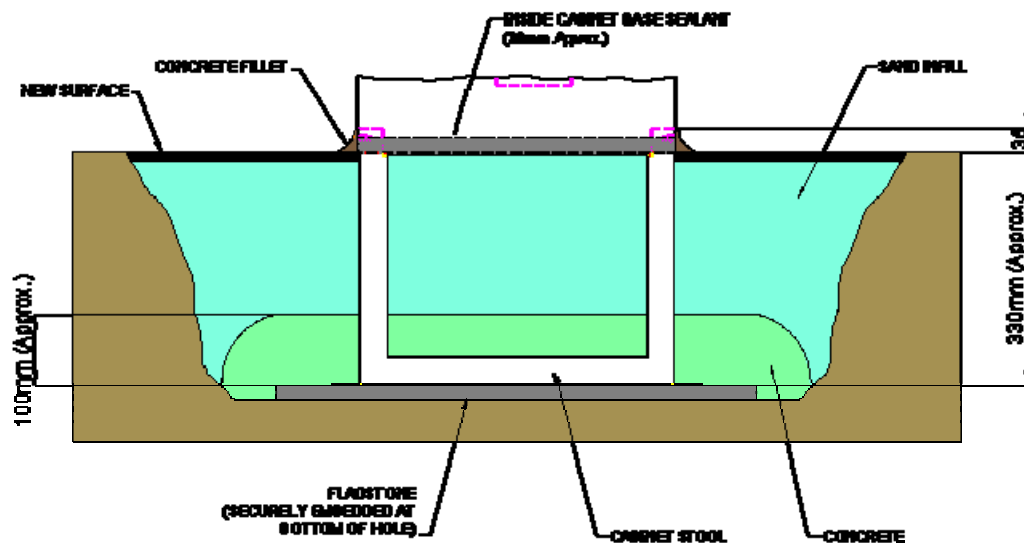


Figure 24 - Stool Installation, Small Cabinet

5.5 Installation of the ST750 Large Cabinet

The following list details the order in which it is recommended that the ST750 installation take place.

- the controller cabinet cannot be made waterproof
- Remove the Rack assembly if necessary – section 5.2
- Install the stool and controller cabinet into the ground – section 5.4.1
- Pull the cables into position – section 5.6
- Terminate the armour to the CET connectors – section 5.6
- Fit the CET glands to the CET bars – section 5.6
- Test the cables – section 5.7
- In-fill with kiln dried sand the controller stool/cabinet base and seal the cabinet base – section 5.9 and 5.10
- Refit the Rack Assembly if applicable – section 5.2
- Terminate the cables – Section 5.6

Occasionally it may be necessary to terminate the cable prior to sealing the base. In the case of the ST750 this will result in the necessity of installing the Rack Assembly into the controller cabinet. It is usually better to seal the base and make provision for the installation of additional cables such as Telecom or fibre cable by installing a suitable size flexible duct. This duct itself may then be sealed with expanding foam sealant.

5.5.1 Remove the controller cabinet from the stool

Remove the stool by removing its four fixing nuts and bolts and lift the controller cabinet off the stool.

5.5.2 Install the stool

A hole should be excavated and a flagstone at least 900mm x 600mm embedded securely at the bottom of the hole. Refer to Figure 25 for the general method of installation and dimensions.

If the ST750 controller cabinet is being installed on a slope, allowance must be made for ground level clearance of the door to the uphill side.

The stool is placed in the centre of the flagstone with the top surface between 50 and 75 mm above the final ground level. **It is essential that the stool be fitted the correct way round with the single centre edge holes to the front and the CET fixing holes on the right, as shown in** Figure 25. Adjustment may be required to ensure that the top of the stool is horizontal; this should be checked using a spirit level.

Mix up a stiff mixture of concrete (mix: 1 cement, 3 sand, 4 coarse aggregate (20mm) with no excess water) and cover the flagstone to a height approximately 100mm (4") above the bottom of the stool. The concrete must be sloped to provide a run up for the cables. Any cables that already enter the pit must be held away from the wet concrete. Where there is a risk of freezing, a suitable antifreeze additive should be incorporated in the concrete mix to ensure proper curing.

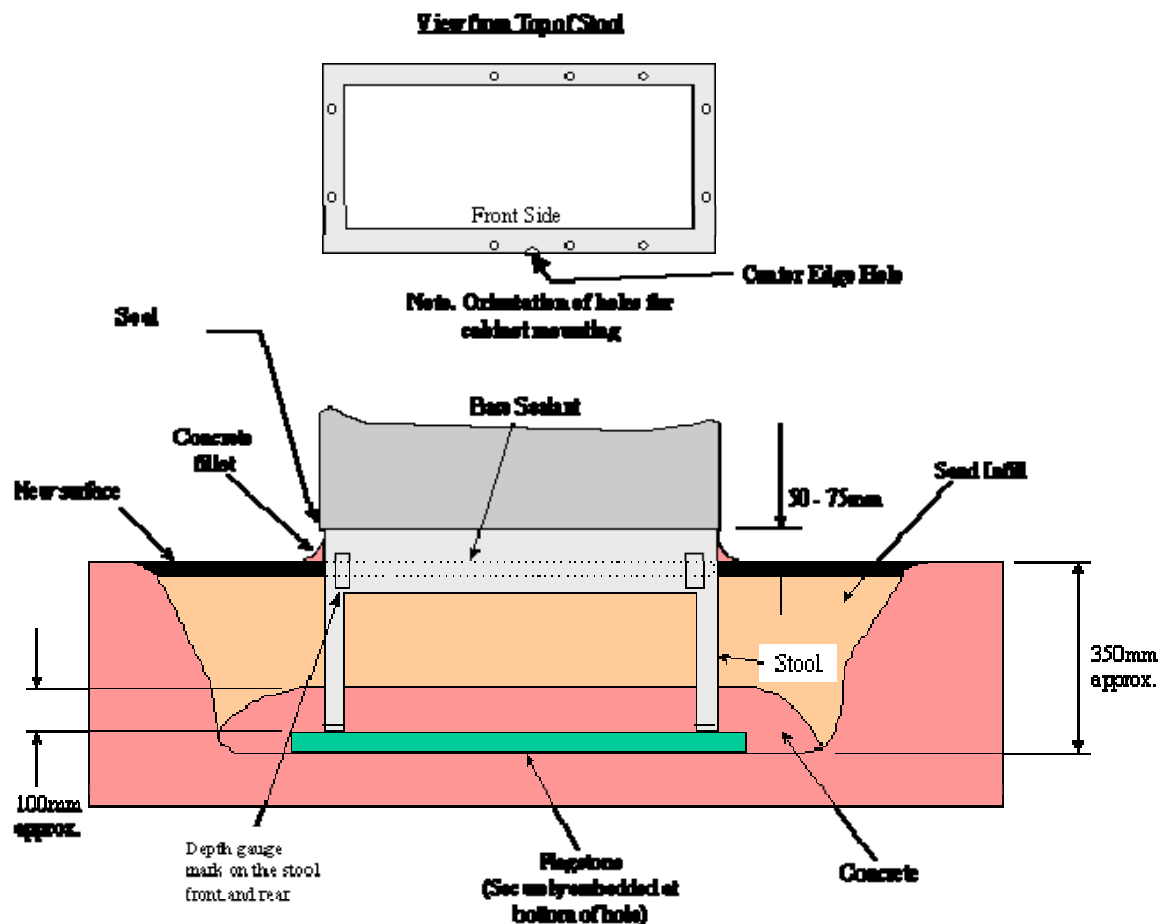


Figure 25 - Stool Installation, Large Cabinet

5.6 Cabling to the ST750 small and large cabinets

All cables into the ST750 controller cabinets should be fed through the ducts and into the stool/base as close to the controller termination positions as possible. This is to prevent unnecessary damage being caused should any cables need to be moved once they are in place. Care must be taken not to obstruct the Electricity Supply Company cut-out with any cabling.

The outer sheathing must be stripped to expose the armouring. It is suggested that between 55mm and 65mm of the inner sheathing is left above the Hose Clip and stripped armour (see Figure 1), which is more than normally required for other Cabinet Assemblies. This is due to the height of the CET bar and its staggered fixing nature. The additional height ensures that double insulation is provided where the cable rests against the metal items. Sufficient further conductor length must also be allowed to reach the terminal blocks via the proper routing.

The cable is inserted in the CET ring and the armoured wires are bent outwards and down against the ring. A hose clip is then placed over the armoured wires and tightened up. The armouring must be stripped, leaving a small amount (approx. 0 to 2mm) below the level of the CET ring.

The inner sheathing is removed to expose the individual cores that are connected to associated terminals, leaving sufficient spare length for re-making off the ends should this become necessary. Unused cores should be left with sufficient length to enable them to be connected to any terminal should this subsequently become necessary.

The ST750S, controller cabinet (Small outer-case) has 2 CET bars and the CET bars are mounted directly to the controller cabinet. Each bar has 8 holes for fixing cables; 4 upper and 4 lower fixing positions. This allows the CET rings and hose clips to overlap each other. The cables must be identified as to their destinations and additional Idents may be required on specific contracts.

The ST750L controller cabinet (Large outer-case) has 2 CET bars as standard, but can be expanded to accommodate additional cables, and the CET bars are mounted directly to the controller cabinet stool. Each bar has 6 holes on each side for fixing cables. These holes are staggered to allow the CET rings and hose clips to overlap each other. The cables must be identified as to their destinations and additional Idents may be required on specific contracts.

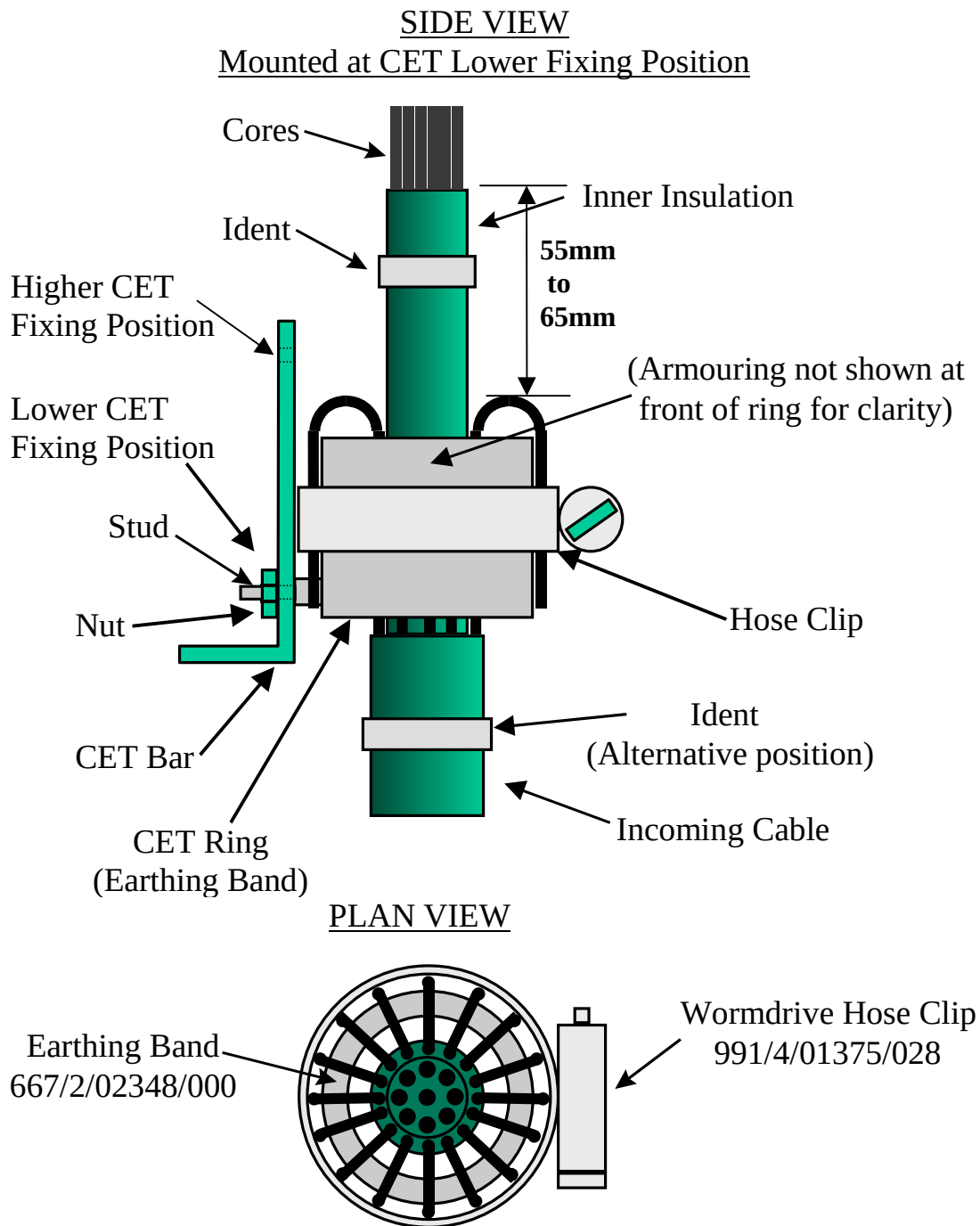


Figure 26 - Termination of Armoured CABLE to CET bar

5.7 On Site Cable Testing

When all the cables have been terminated onto the CET bar they should be checked and tested as defined in the General Installation and Commissioning Handbook 667/HE/20664/000

5.8 Fit the cabinet to the Stool

If the controller cabinet was not installed with the mounting stool then it should be done as follows:

Clean the top surface of the stool and the lower surface of the cabinet that will be in contact when the cabinet is fitted.

The cabinet is installed by lowering it onto the stool and fitting the four retaining bolts.

When fitting the cabinet onto the stool, make sure that all the cables are in their correct position with regard to the CET bar. Once the cabinet has been secured, moving of the cables could cause damage.

5.9 Back fill and in-fill the stool

On completion of the cable tests the controller cabinet and stool can be back-filled by the civils team using the appropriate material for the site layout. Once the back-fill is completed in-fill with kiln dried sand as per Figure 24 and Figure 25, taking care that the compacted sand is at ground level when finished.

If any of the cables were replaced or moved during the installation of the controller cabinet then the kiln dried sand in-filling must be made good before the sealing compound is introduced.

NOTE: The back-fill must be brought to a level such that once the decorative top surface is completed that the finish is at the surrounding ground level. The site should be finished to the requirements listed in section 5.3 particularly paying attention to any hardstanding around the controller base.

5.10 Sealing the base of the controller outer case

To prevent condensation and infestation in the controller cabinet the base **MUST** be sealed as soon as possible after the controller has been installed. If any of the cables were replaced or moved during the installation of the controller the kiln dried sand in-filling must be made good before the sealing compound is introduced.

NOTE: -

The in-filling, kiln dried sand, must be brought to ground level or above and compacted. Make sure that the kiln dried sand is level or slightly sloped down where it meets the cables so it will not prevent the sealant meeting the cable.

The sealant should be poured all around the cables and to a height which, when the sealant is set, gives a total covering not less than 6.5mm thick over the base of the controller cabinet base. Use between 2.0 to 3.0 litres of approved epoxy resin for the large controller cabinet base and 2.0 Litres for the small controller cabinet base this will give an adequate and even cover.

This will act as a preventative barrier against the ingress of moisture and animal/insect infestation.

A concrete fillet around the outside of the stool may be completed before or after the epoxy sealing to suit site conditions.

Refer to Figure 24 and Figure 25 for general method of in-fill, kiln dried sand, sealing and concrete fillet.

Warning!

Should the controller cabinet base/stool NOT be in-filled with kiln dried sand and sealed with an approved epoxy resin the controller electronics/electrical circuits may be damaged.

5.11 CABLE ROUTING & TERMINATION

The following guidelines apply when the ST750 Rack Assembly is installed in the ST750 Cabinet Assembly or any other controller cabinet.

All intersection cables and their wires must be secured within the cabinet using ty-wraps once terminated.

Note: No wire runs or looms should be positioned directly above the ST750 Rack Assembly, as this would prevent its removal for maintenance or replacement. In the back of the metal frame across the top of the ST750 Rack Assembly, securing holes are provided to secure the detector wire looms. These holes ensure that there is sufficient room to allow the removal of the ST750 Rack Assembly.

Wiring runs should be made neatly and routed to allow enough spare cables for possible changes/additions at a later date.

Spare cores are to be bundled and routed to a convenient position clear of mains. The ends are to be insulated to make the loom secured. Spare cores of ELV cables are to be loomed separately from the cores of LV cables.

If cable idents are required then these are fitted to cores before termination.

Signal and Detector terminations to the ST750 Rack Assembly should be as per the Works Specification, leaving sufficient spare wire to enable joints to be remade when necessary. The 'Pair' cable used for connection from the loops should be terminated using the appropriate kit.

OMU must monitor the Controller Lamp Supply at the screw terminal on SK2 Pin 6.

Note: The following connectors' identification, signal allocation, coding information (when required) and Softwire colours (when used) are given as guidance to assist the installation engineer, when wiring to the Works Specification. No Softwire Kit is required to wire an ST750 Rack Assembly into an ST750 Cabinet as the Intersection Cables can be wired directly to the ST750 terminals. Softwire Kits are available to install an ST750 in other Cabinets. If the Softwire kit is used in the ST750 cabinet assembly, then their associated terminal blocks are mounted on the right hand side

and back of the cabinet's inner metal frame. The position of these terminal blocks means that a short screwdriver (No1 Pozidriv) is required to terminate the wires due to the proximity of the dimming transformer (if fitted). If there are many cables, access to the terminal blocks becomes restricted.

5.11.1 Phase Drive PCB Terminal blocks

For installation in an ST750 Cabinet, wire the intersection cables directly to the specified connector in the following tables (using the respective mating half contained in the attached plastic bag) on the Phase Drive PCB.

The connectors must be wired as follows:

- Ensure 10mm of wire insulation is stripped back
- Make sure that the connector is fully undone (open) before inserting the stripped wire end
- Insert the stripped wire end fully to the back stop
- Firmly tighten the connector's terminal screw ensuring that the wire's conductor is firmly positioned correctly in the connector

Warning: The above method must be used. Failure to do so could result in the wires coming loose or falling out over a short period of time.

For installation in another cabinet, a Softwire Kit is required. Wire the loose ends of the Softwire kit Cableform to the cabinet terminal blocks. Use the relevant signals as defined by the works specification and shown in the tables that follow. Figure 27 also provides further information on PL6, PL7 and PL8.

Table 6 – Phase Drive PL6 Connector

PL6 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/000	
		Colour	Ident
1	Red Phase A (Unmonitored)	Red	RAU
2	Monitored Red Phase A Approach 1		
3	Monitored Red Phase A Approach 1	Red	RA1
4	Monitored Amber Phase A Approach 1	Yellow	YA1
5	Monitored Green Phase A Approach 1	Green	GA1
6	Monitored Red Phase A Approach 2		
7	Monitored Red Phase A Approach 2	Red	RA2
8	Monitored Amber Phase A Approach 2	Yellow	YA2
9	Monitored Green Phase A Approach 2	Green	GA2
10	<i>Not used (for isolation purposes)</i>		
11	Red Phase B	Red	RB
12	<i>Not used (for isolation purposes)</i>		
13	Amber Phase B	Yellow	YB
14	Amber Phase B		

		Softwire kit Cableform 667/1/27877/000	
15	<i>Not used (for isolation purposes)</i>		
16	Green Phase B	Green	GB

Coding Details: The plug mount connector on the Phase Drive board PL6 has coding pins 2 and 15 fitted, with the cable fitted socket connector that mates with PL6 having coding pins 1 and 16 fitted. This coding prevent the incorrect connection between PL6 and PL7. For more details see the following diagram:

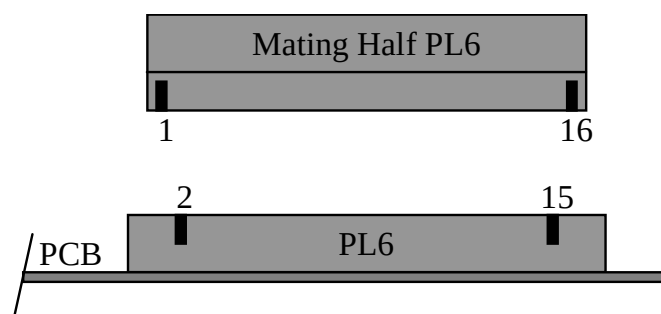


Table 7 – Phase Drive PL7 Connector

PL7 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/000	
		Colour	Ident
1	Red Phase C (Unmonitored)	Red	RAU
2	Monitored Red Phase C Approach 1		
3	Monitored Red Phase C Approach 1	Red	RA1
4	Monitored Amber Phase C Approach 1	Yellow	YA1
5	Monitored Green Phase C Approach 1	Green	GA1
6	Monitored Red Phase C Approach 2		
7	Monitored Red Phase C Approach 2	Red	RA2
8	Monitored Amber Phase C Approach 2	Yellow	YA2
9	Monitored Green Phase C Approach 2	Green	GA2
10	<i>Not used (for isolation purposes)</i>		
11	Red Phase D	Red	RB
12	<i>Not used (for isolation purposes)</i>		
13	Amber Phase D	Yellow	YB
14	Amber Phase D		
15	<i>Not used (for isolation purposes)</i>		
16	Green Phase D	Green	GB

Coding Details: The plug mount connector on the Phase Drive board PL7 has coding pins 1 and 16 fitted, with the cable fitted socket connector that mates with PL7 having coding pins 2 and 15 fitted. This coding prevent the incorrect connection between PL7 and PL6. For more details see the following diagram:

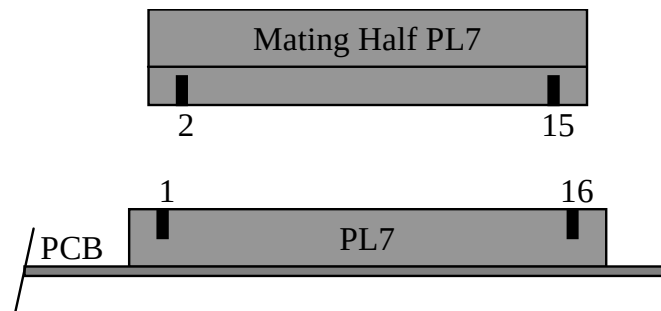


Table 8 – Phase Drive PL8 Connector for ST750 Phase Driver PCB (6 Phase)

PL8 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/050	
		Colour	Ident
1	Red Phase 5 (Unmonitored)	Red	RED5
2	Amber Phase 5 (Unmonitored)	Yellow	YLW5
3	Green Phase 5 (Unmonitored)	Grey	GRN5
4	Red Phase 6 (Unmonitored)	Red	RED6
5	Amber Phase 6 (Unmonitored)	Yellow	YLW6
6	Green Phase 6 (Unmonitored)	Grey	GRN6

Coding Details: This connector has no coding element, as it is the only 6-way connector.

Table 9 – Phase Drive PL8 Connector for ST750LED Phase Driver PCB

PL8 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/32756/000	
		Colour	Ident
1	Monitored Red Phase A RLM Channel 3	Red	RA3
2	Monitored Red Phase A RLM Channel 4	Red	RA4

Coding Details: This connector has no coding element, as it is the only 2-way connector.

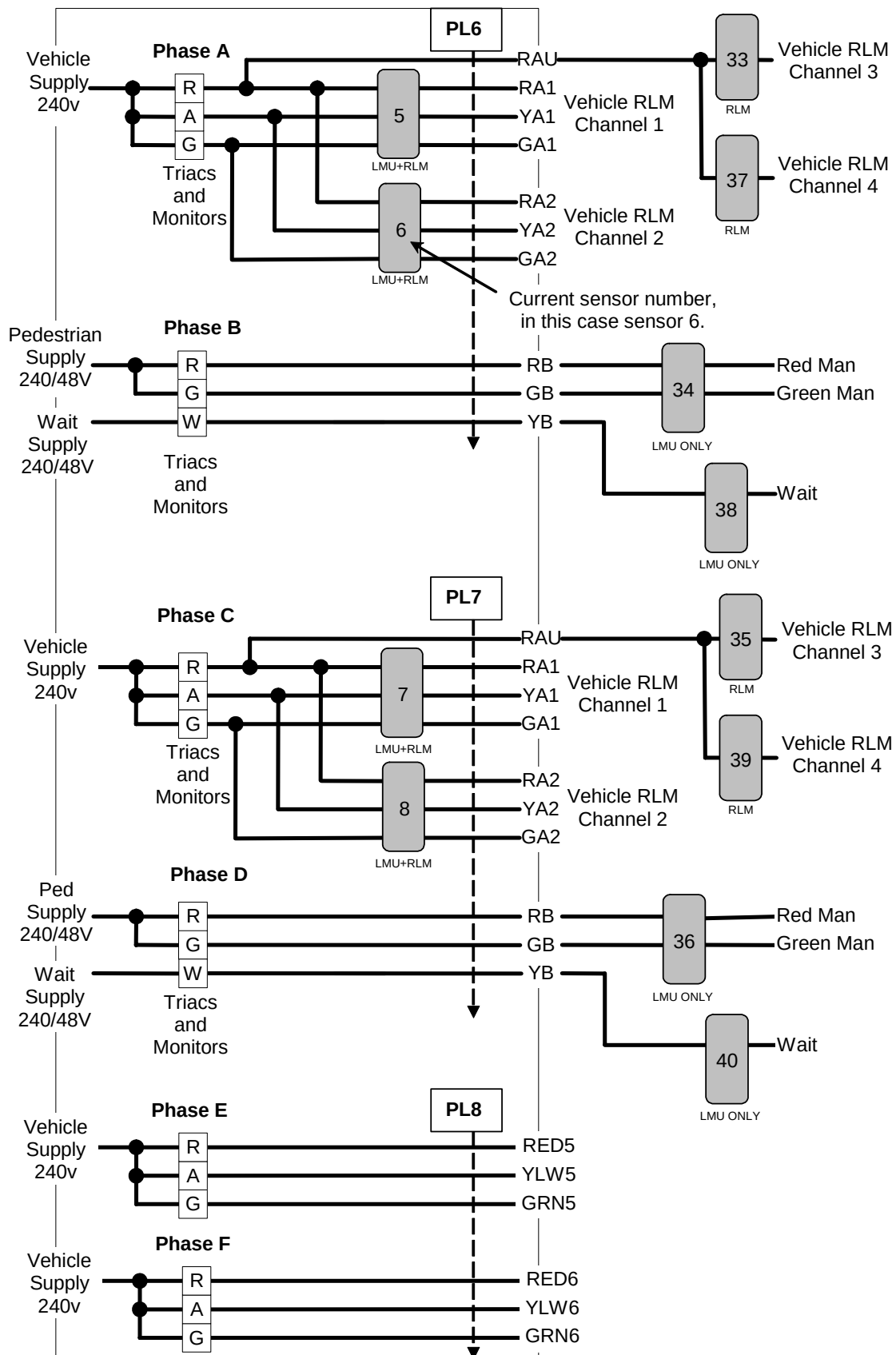


Figure 27 - Allocation of Red Lamp Monitor Channels for ST750 Controllers without LV CLS (NLM) monitoring

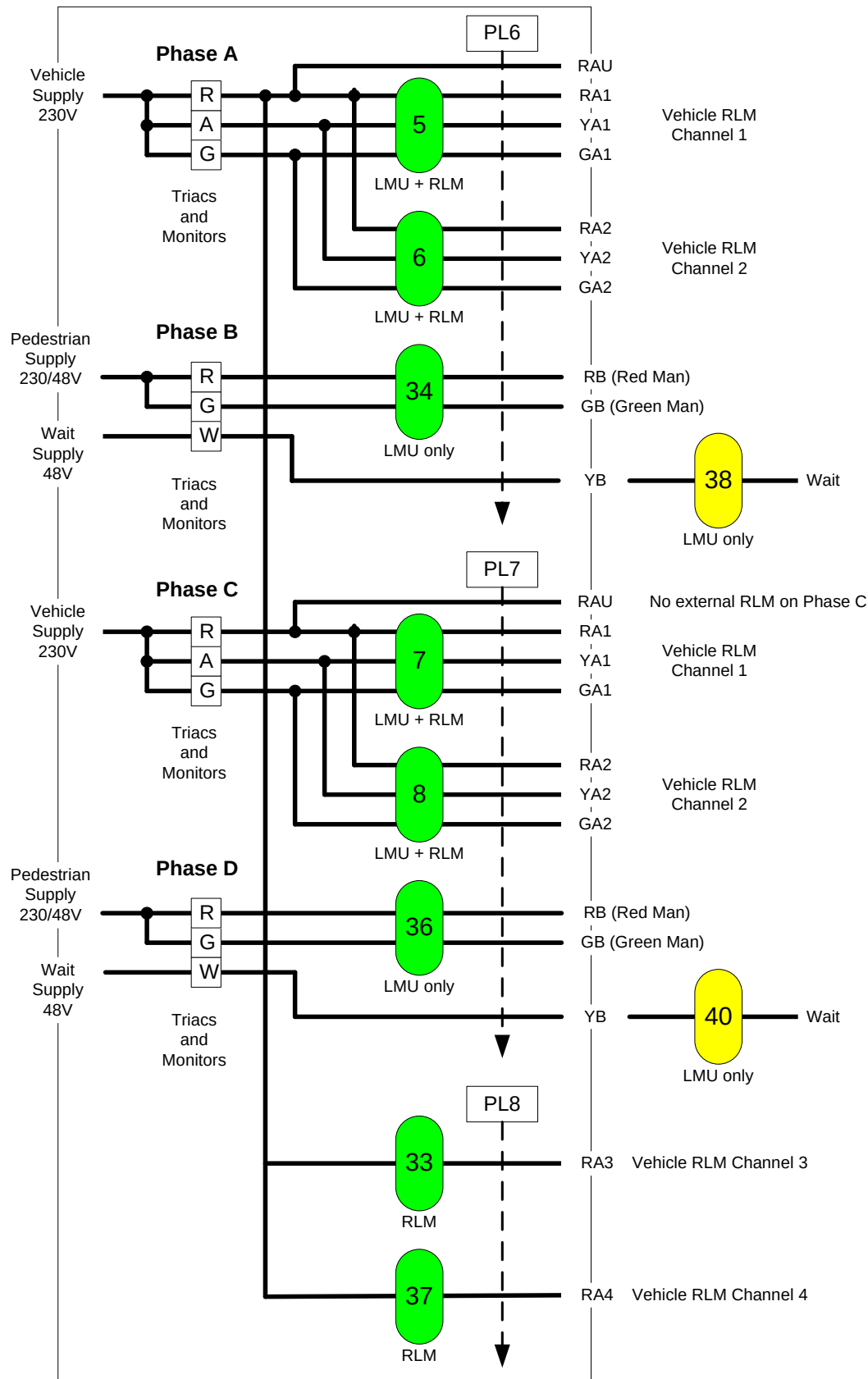


Figure 28 - Allocation of Red Lamp Monitor Channels for ST750LED Controllers with LV CLS (NLM) monitoring

Table 9 – Phase Drive SK1 Connector

SK1 Pin No	Signal Phase Drive Returns, Solar Cell, Detector and AUX mains supplies	Softwire kit Cableform 667/1/27872/000		
		Colour	Ident	TB1
1	Signal Lamp Supply Return	Blue	None	4
2	Signal Lamp Supply Return	See note 1		
3	Signal Lamp Supply Return	See note 1		
4	Signal Lamp Supply Return	See note 1		
5	Signal Lamp Supply Return	See note 1		
6	Signal Lamp Supply Return	See note 1		
7	Signal Lamp Supply Return	Blue	None	12
8	Aux Mains Supply			
9	Aux Mains Supply 2 (not used)			
10	230V Detector Supply	Pink	DET	2
11	Solar Cell Live	Pink	SOLAR LIVE	3
12	Solar Cell Input	Pink	SOLAR CELL	1
13	<i>Not used (for isolation purposes)</i>			
		Softwire kit Cableform 667/1/27864/000		
		Colour	Ident	TB1
14	48V Lamp Supply Return	Orange	None	6
15	48V Lamp Supply Return	See note 2		
16	48V Lamp Supply Return	See note 2		
17	48V Lamp Supply Return	Orange	None	12

Note 1 These neutrals are not used as TB1 block part of cable form is linked between terminals 4 to 12, but these outputs can be used when wired direct in an ST750 cabinet installation.

Note 2 These 48V returns are not used as TB1 block part of cable form is linked between terminals 6 to 12, but these outputs can be used when wired direct in an ST750 cabinet installation.

Coding Details: Connector SK1 has no coding elements as it is the only 17-way connector and can only be inserted one way.

Table 10 – Phase Drive PL1 Connector

PL1 Pin No	Controller Mains I/P	Softwire kit Cableform 667/1/27874/000 or /001
		Colour
1	Live 230V Mains Supply	Pink
2	Neutral 230V Mains Supply	Blue
3	Earth Connection	Green/Yellow

Coding Details: Connector PL1 has no coding elements, as it is the only 3-way connector and can only be inserted one way.

Table 11 – Phase Drive SK2 Connector No Dimming

If the installation has no Dimming Transformer, then insert the Cableform 667/1/27868/002. This cable is provided as standard with rack assemblies. Cabinet assemblies have a dimming transformer fitted as standard, which includes the cable 667/1/27868/000. See Table 12 below for details.

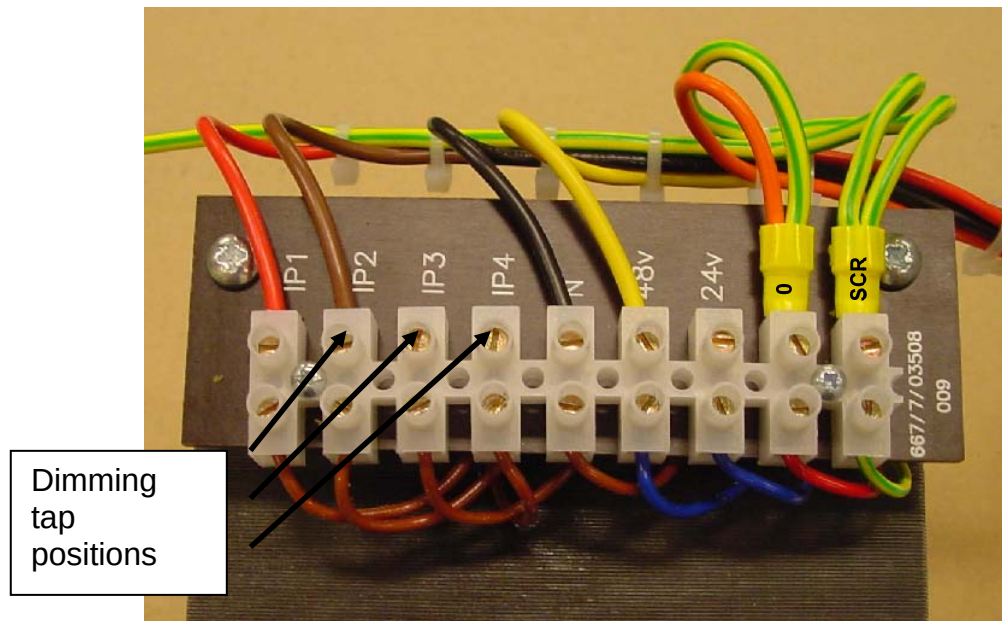
SK2 Pin No	Softwire kit Cableform 667/1/27868/002
	Connection
1	-
2	-
3	Short to pin 6
4	Short to pin 5
5	Short to pin 4
6	Short to pin 3
7	-
8	-
9	-
10	-

Table 12 – Phase Drive SK2 48V Dimming Connections

Normally the ST750 in its own cabinet is fitted with the cable 667/1/27868/000 described below (see also Figure 28):

SK2 Pin No	48V Dimming Transformer's I/P	Softwire kit Cableform 667/1/27868/000	
		Colour	Dim Transformer Connection
1	Dim I/P 1	Red	I/P1
2	Dim I/P 2, 3 or 4	Brown	I/P 2 etc
3	Dim Relay Common		Short to pin 5
4	Dim Relay n/c		Short to pin 6
5	B Relay O/P		Short to pin 3
6	Lamp Supply		Short to pin 4
7	Neutral	Black	Neutral
8	Not used		
9	48V Supply	Yellow	48V
10	48V Return	Orange	0V

Figure 29 - Dimming Transformer Tap Selection



Required Dimming voltage	Input Tap
160V	IP2
140V	IP3
120V	IP4

If the ST750 is installed in another cabinet, the 667/1/27868/001 cable should be used with connections as shown above. This cable is provided with the cabinet modification kit.

Note 1: The links between pins 3 to 6 need to be rearranged.

Note 2: The Screen (SCR) and 48V Return connections on the Dimming Transformer need to be linked together and connected to the Earth Star point in the controller cabinet with a length of yellow/green wire.

Coding Details: Connector SK2 has no coding elements, as it is the only 10-way connector and can only be inserted one way.

Table 13 – Phase Drive PL5 Connector

PL5 Pin No	External Lamp Monitoring Sensors
1	External Sensor 33 – Red
2	External Sensor 33 – White
3	External Sensor 34 – Red
4	External Sensor 34 – White
5	External Sensor 35 – Red
6	External Sensor 35 – White
7	External Sensor 36 – Red
8	External Sensor 36 – White

9	External Sensor 37 – Red
10	External Sensor 37 – White
11	External Sensor 38 – Red
12	External Sensor 38 – White
13	External Sensor 39 – Red
14	External Sensor 39 – White
15	External Sensor 40 – Red
16	External Sensor 40 – White

Note that the ST750LED Phase Driver PCB with LV CLS (NLM) monitoring only has connections on PL5 for External Sensors 38 and 40 (Phase B and Phase D Waits).

Coding & Wiring Details: Connector PL5 is a 20-way Berg connector that has a side flange coding element, which mates with the associated slot of the IDC board mounted 16-way connector. The pin positions 1, 2, 19 & 20 on the Berg connector are not used for wiring purposes but are used to provide a stop for the IDC board mounted connector locking levers. See the following diagram:

Connector PL5 and its Mating Half (Berg Connector) Viewed from the Top

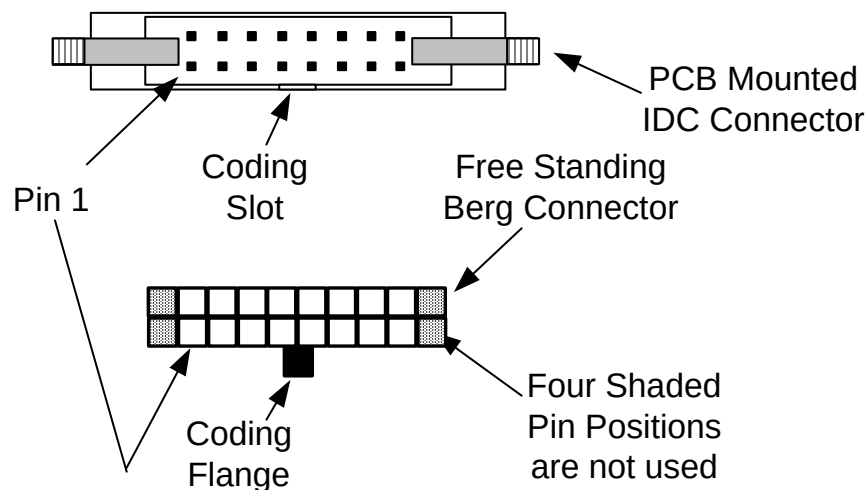


Figure 30 - Connector PL5

Instead of driving all the signals at the 230V nominal supply, the ST750 is capable of driving the Wait indicators or all the pedestrian phase signals directly with an ELV 48V lamp supply.

Switching the supply from 230V to 48V requires fuses and links on the lamp switch card to be re-arranged as detailed in Section 5.13. The required arrangement also needs to be configured (using the ELV handset command) and affects what sensors 34 and 38 (or 36 and 40 on the second stream) can monitor. See the following table:

ELV:0 – All signals at 230v	ELV:1 – Waits at 48v	ELV:2 – All ped signals at 48V
34/36 – Monitor Red+Green	34/36 – Monitor Red+Green (Red & Green thro' toroid twice) (Wait cables thro' toroid once)	34/36 – Monitor Red+Green (all cables thro' toroid once)
38/40 – Not Required Wait (all cables thro' toroid twice)	38/40 –Monitor Wait (Wait cables thro' toroid once)	38/40 –Monitor Wait (all cables thro' toroid once)

Note

At the time of writing, the controller is unable to monitor the current waveform generated by the low power near-sided signals currently on the market.

Wiring of external toroids

All drive cables supplying signals at 230V should be wound around the toroid so the cable passes through the centre twice. (N.B. This includes vehicle aspects as well as pedestrian aspects.)

All drive cables supplying signals at 48V should only pass through the centre of the toroid once.

5.11.2 ST750 CPU PCB Terminal Blocks

When installing in an ST750 cabinet, wire the intersection cables directly to the specified connector in the following tables (using the respective mating half contained in the attached plastic bag) on the ST750 CPU PCB.

The connectors must be wired as follows:

- Ensure 9mm of wire insulation is stripped back
- Make sure that the connector is fully undone (open) before inserting the stripped wire end
- Insert the stripped wire end fully to the back stop
- Firmly tighten the connector's terminal screw ensuring that the wire's conductor is firmly positioned correctly in the connector

Warning: The above method must be used. Failure to do so could result in the wires coming loose or falling out over a short period of time. Also, the connectors PL2, PL3, PL6 and PL7 require a small-ended (2.5mm) screwdriver. Use a Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent (see note at the top of each table).

When installing in any other cabinet, a Softwire kit is required. Wire the loose wire ends of the Softwire kit cableform to the terminal blocks in the cabinet, using the relevant signals as defined by the works specification and shown in the tables that follow:

Table 14 – Processor Card PL3 Connector

Note: These terminals must be tightened correctly, using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL3 PCB Connector Pin No	Controller Isolated O/P, Tactile and Audible Circuits	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	O/P 88 Common	Brown	TBX1
2	O/P 88 Closed Contact	Red	TBX2
3	O/P 89 Common	Orange	TBX3
4	O/P 89 Closed Contact	Yellow	TBX4
5	O/P 90 Common	Green	TBX5
6	O/P 90 Closed Contact	Blue	TBX6
7	O/P 90 Open Contact	Not used	-
8	O/P 91 Common	Slate	TBX7
9	O/P 91 Closed Contact	White	TBX8
10	O/P 91 Open Contact	Not used	-
11	Tactile Phase B	Red/Orange	TBX10
12	Audible Phase B Loud	Red/Green	TBX11
13	Audible Phase B Quiet	Red/Brown	TBX12

Coding Details: The plug mount connector on the CPU PCB PL3 has coding pins 2, 8 and 13 fitted, with the cable fitted socket connector that mates with PL3 having coding ridges 2, 8 and 13 removed. This coding prevent the incorrect connection between PL3 and PL2. For more details see the following diagram:

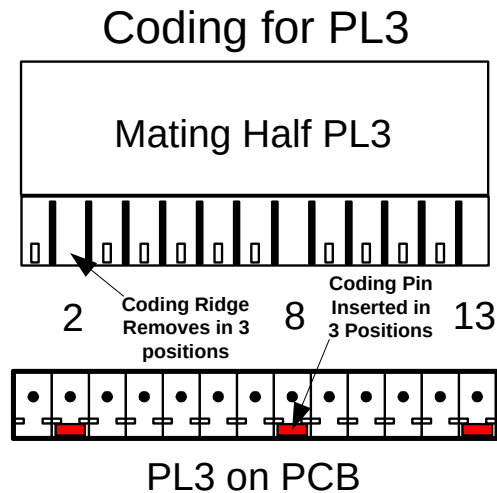


Figure 31 - Connector PL3

Table 15 – Processor Card PL7 Connector

Note: These terminals must be tightened correctly using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL7 PCB Connector Pin No	Controller I/P	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	Input 0	Brown	TBG1
2	Input 1	Red	TBG2
3	Input 2	Orange	TBG3
4	Input 3	Yellow	TBG4
5	Input 4	Green	TBG5
6	Input 5	Blue	TBG6
7	Input 6	Violet	TBG7
8	Input 7	Slate	TBG8
9	Input 8	White	TBH1
10	Input 9	Black	TBH2
11	Input 10	Red/Orange	TBH3
12	Input 11	Red/Green	TBH4
13	Input 12	Red/Brown	TBH5
14	Input 13	Green/Orange	TBH6
15	Input 14	Green/Brown	TBH7
16	Input 15	Green/Slate	TBH8

Coding Details: The plug mount connector on the CPU PCB PL7 has coding pins 2, 8 and 16 fitted, with the cable fitted socket connector that mates with PL7 having coding ridges 2, 8 and 16 removed. This coding

prevents the incorrect connection between PL7 and PL6. For more details see the following diagram:

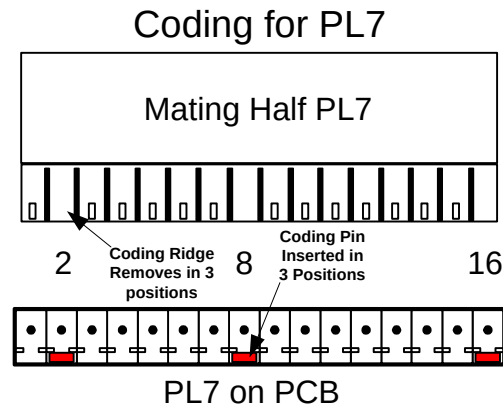


Figure 32 - Connector PL7

Table 16 – Processor Card PL2 Connector

Note: These terminals must be tightened correctly using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL2 PCB Connector Pin No	Controller Isolated O/P, Tactile and Audible Circuits	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	O/P 92 Common	Brown	TBY1
2	O/P 92 Closed Contact	Red	TBY2
3	O/P 93 Common	Orange	TBY3
4	O/P 93 Closed Contact	Yellow	TBY4
5	O/P 94 Common	Green	TBY5
6	O/P 94 Closed Contact	Blue	TBY6
7	O/P 94 Open Contact	Not used	-
8	O/P 95 Common	Slate	TBY7
9	O/P 95 Closed Contact	White	TBY8
10	O/P 95 Open Contact	Not used	-
11	Tactile Phase D	Red/Orange	TBY10
12	Audible Phase D Loud	Red/Green	TBY11
13	Audible Phase D Quiet	Red/Brown	TBY12

Coding Details: The plug mount connector on the CPU PCB PL2 has coding pins 1, 6 and 12 fitted with the cable fitted socket connector that mates with PL2 having coding ridges 1, 6 and 12 removed. This coding prevent the incorrect connection between PL2 and PL3. For more details see the following diagram:

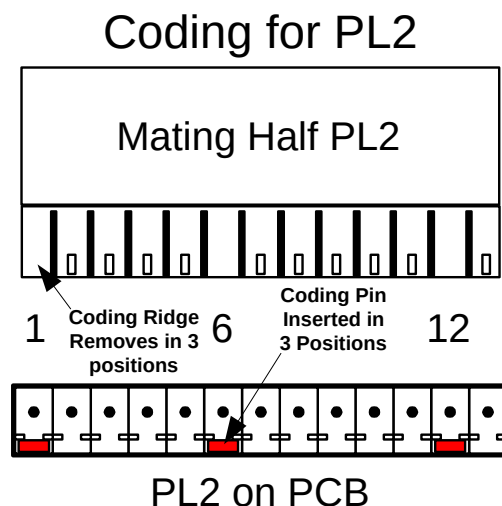


Figure 33 - Connector PL2

Table 17 – Processor Card PL6 Connector

Note: These terminals must be tightened correctly using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL6 PCB Connector Pin No	Controller I/P	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	Input 16	Brown	TBJ1
2	Input 17	Red	TBJ2
3	Input 18	Orange	TBJ3
4	Input 19	Yellow	TBJ4
5	Input 20	Green	TBJ5
6	Input 21	Blue	TBJ6
7	Input 22	Violet	TBJ7
8	Input 23	Slate	TBJ8
9	Input 24	White	TBL1
10	Input 25	Black	TBL2
11	Input 26	Red/Orange	TBL3
12	Input 27	Red/Green	TBL4
13	Input 28	Red/Brown	TBL5
14	Input 29	Green/Orange	TBL6
15	Input 30	Green/Brown	TBL7
16	Input 31	Green/Slate	TBL8

Coding Details: The plug mount connector on the CPU PCB PL6 has coding pins 1, 7 and 15 fitted, with the cable fitted socket connector that mates with PL6 having coding ridges 1, 7 and 15 removed. This coding

prevent the incorrect connection between PL6 and PL7. For more details see the following diagram:

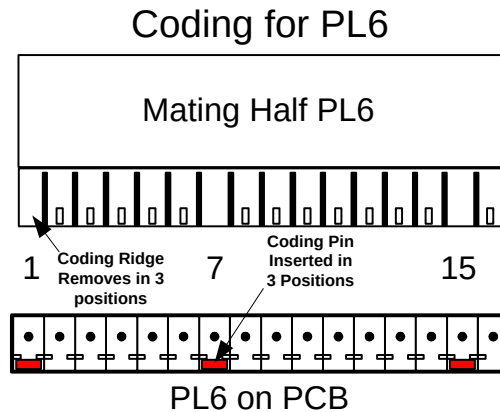


Figure 34 - Connector PL6

5.12 REGULATORY SIGNS MONITORING

The ST750 Rack Assembly does not cover regulatory signs and their associated monitoring. There is a fuse position labelled 'F3 Detector' which could be used to supply regulatory signs if required. Their monitoring would require standard current coils to be connected to the external analogue inputs.

5.13 PCB SWITCHES, FUSES, LINKS AND FIRMWARE

The switches, fuses and link settings are related to the hardware options; their locations and option selections are shown in Sections 5.13.1 and 5.13.2.

To aid the location identification an overview of each card is also given:

5.13.1 CPU PCB Switch and Link Setup

See the following pages for switch and link settings.

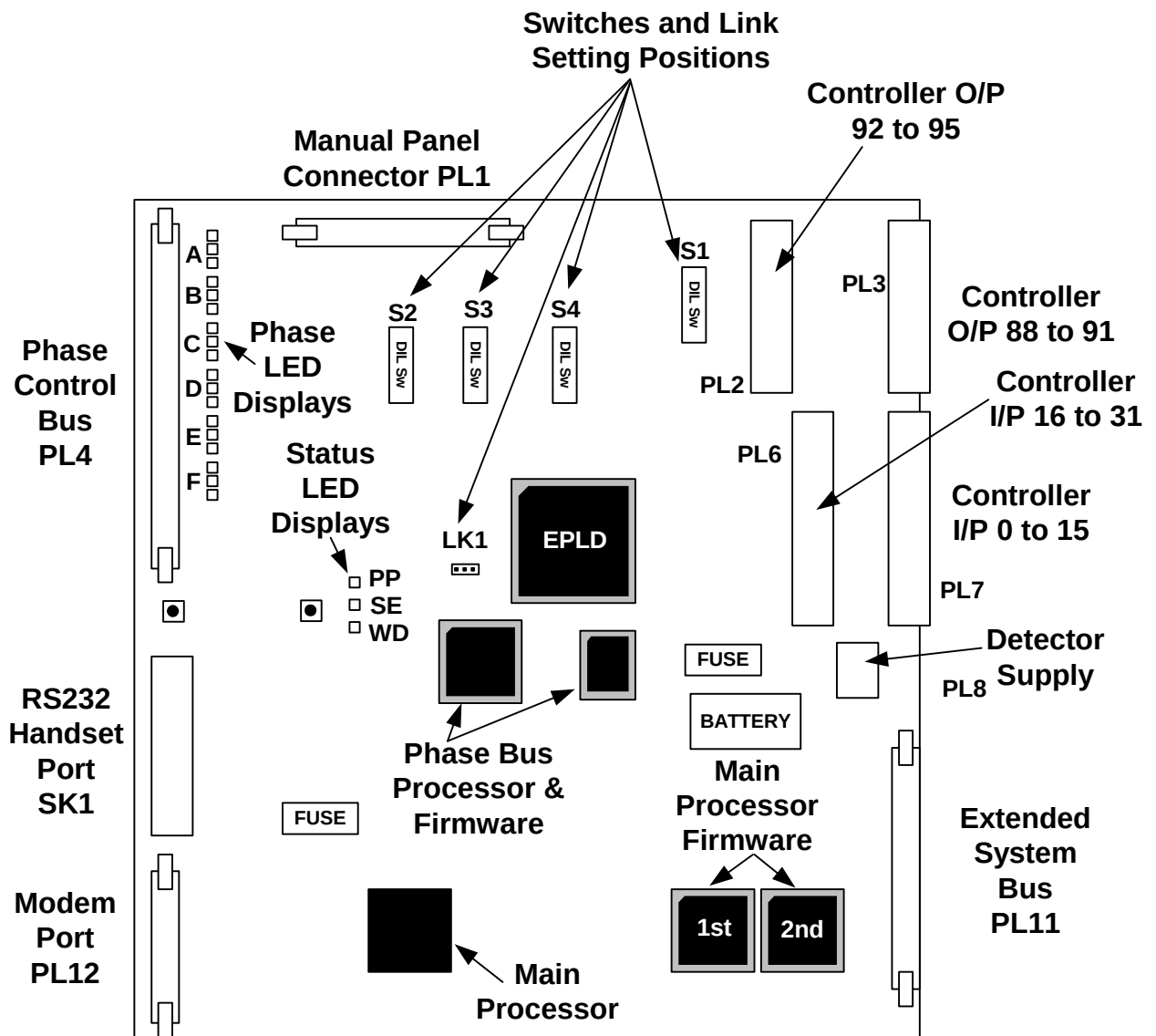


Figure 35 – CPU PCB

5.13.1.1 DIL Switch S4 Settings

For use in the UK, the hardware fail flash facility should be disabled. The settings are shown in Figure 36.

For use in Non-UK versions, the flash rate can be set to different speeds for 40ms to 600ms (on 50Hz operation) by setting the right combination of S4 switches to the off position. The set-up is detailed as follows:

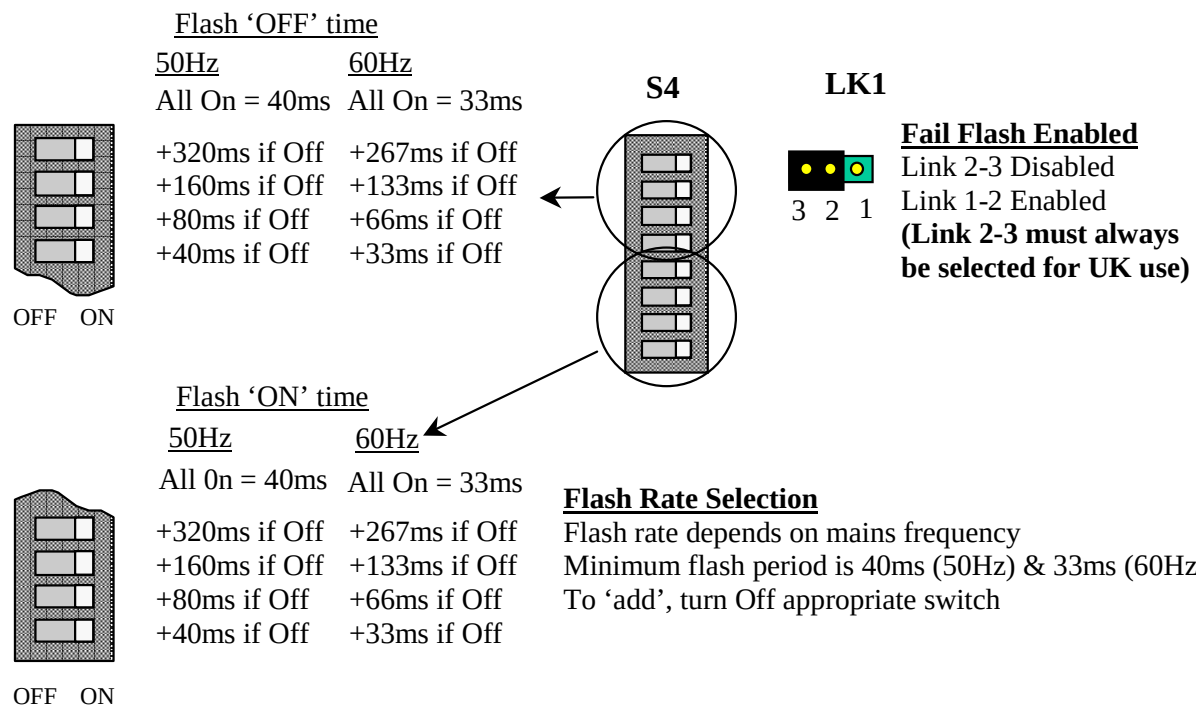


Figure 36 – Flash Rate Settings

5.13.1.2 DIL Switch S2 & S3 Settings

For use in the UK these switches should be set to the OFF position. The settings are shown in Figure 37.

For Non-UK versions, each of the six phases can be set individually to flash either Red (using S2) or Amber (using S3), or both Red and Amber when the hardware fail flash is activated.

The set-up of each phase to the required colours is detailed as follows:

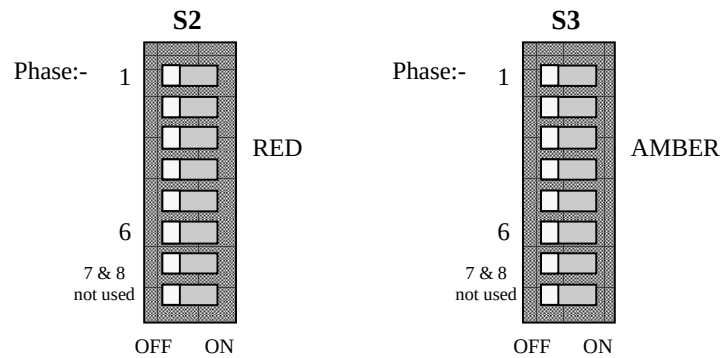


Figure 37 – Phase Output Flash Selection

5.13.1.3 DIL Switch S1 Settings

The value of the series resistance for the relay contacts can be set to either 182 ohms or 22 ohms and is set on switch S1 as follows:

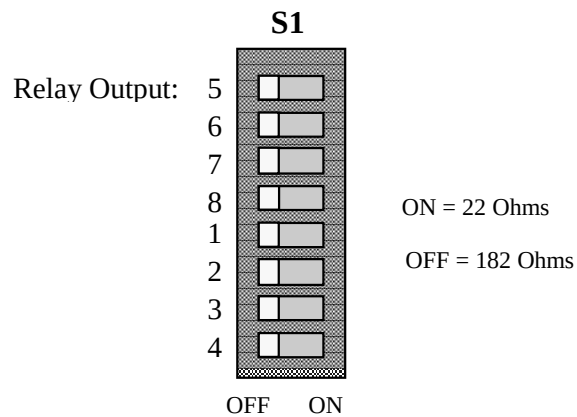


Figure 38 – Relay Output Resistance Selection

5.13.2 Phase Drive PCB Switches, Links and Fuses Setup

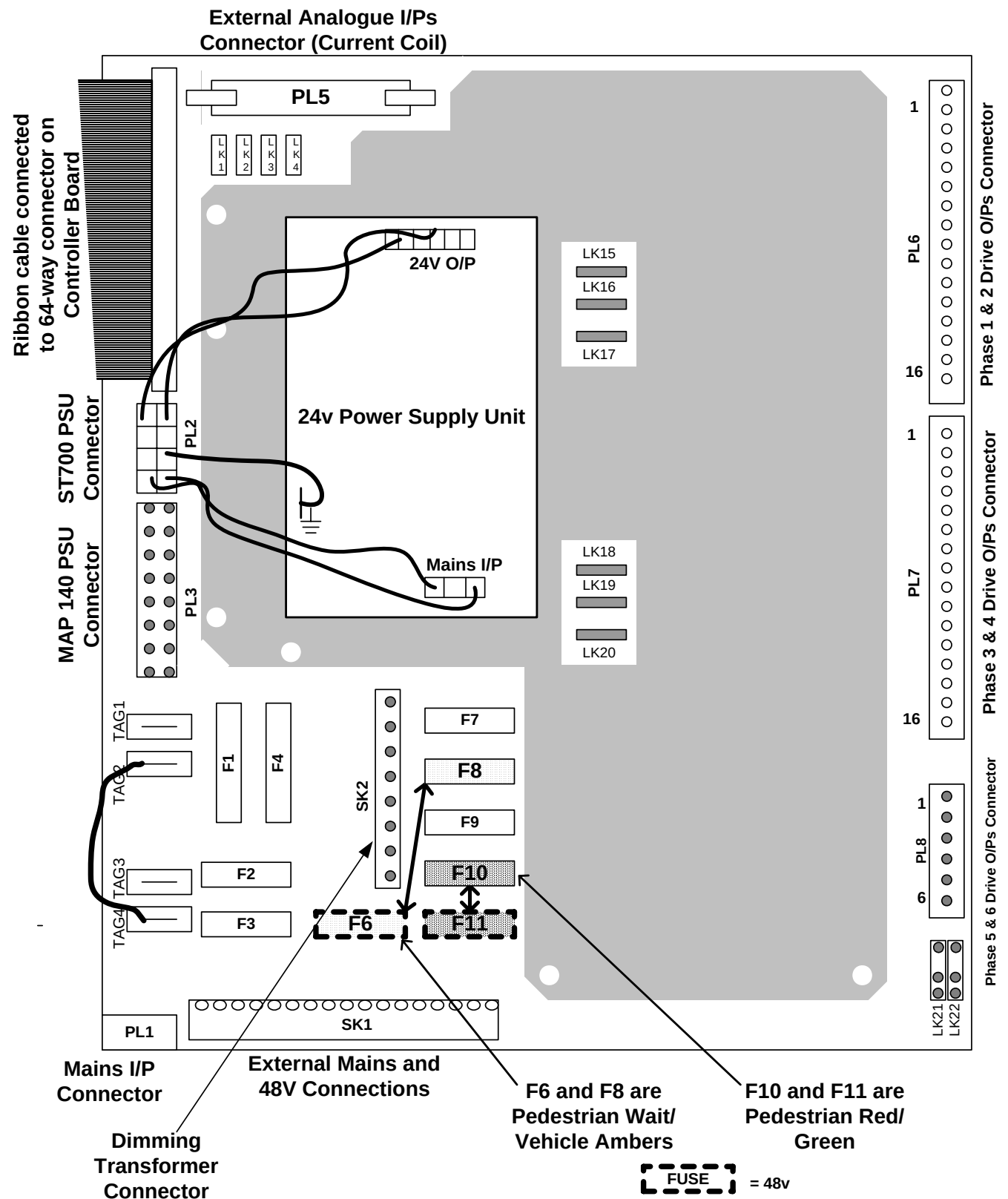


Figure 39 – ST750 Phase Drive PCB Assembly

5.13.2.1 Fuse/Dummy Fuse Settings

The output voltage for the Pedestrian Red and Pedestrian Green can be set to either 230V or 48V operation. Fitting the fuse and dummy fuse as follows sets the voltage:

- For **230V** operation fit the 10A fuse in F10 and the dummy fuse in F11.
- For **48V** operation fit the 10A fuse in F11 and the dummy fuse in F10.

The output voltage for the Pedestrian Waits can be set to either 230V or 48V operation. Fitting the fuse and dummy fuse as follows sets the voltage:

- For **230V** operation fit the 10A fuse in F8 and the dummy fuse in F6.
- For **48V** operation fit the 10A fuse in F6 and the dummy fuse in F8.

Note that the ST750LED Phase Driver PCB with LV CLS (NLM) monitoring always provides Waits at 48V, so F8 does not exist, and F6 is always fitted.

Note: The dummy fuse is a plastic spacer, the same size as the fuse it replaces. It is used to prevent service personnel inserting an extra fuse and thus causing damage to occur to the ST750.

5.13.2.2 Blue and Red Handbag Links Settings

The output voltage monitoring circuits for the Pedestrian Red and Pedestrian Green can be set to monitor either 230V or 48V. Inserting the correct coloured handbag links on the board sets the voltages for the Monitoring circuit. The positions and colours are as follows:

- For **230V** operation fit only a Red Link in position LK22 (large pitch).
- For **48V** operation fit only Blue Links in positions LK22 (small pitch), LK15 and LK17. On 4 phase units fit LK18 and LK20.

Note: Links LK15, LK17, LK18 and LK20 are accessed through the two rectangular cut outs in the heatsink cover. See Figure 39 for details. A pair of long nose pliers is required to insert and extract the handbag links.

The output voltage monitoring circuits for the Pedestrian Wait can be set to monitor either 230V or 48V. Inserting the correct coloured handbag links on the board sets the voltages for the Monitoring circuit. The positions and colours are as follows:

- For **230V** operation fit only a Red Link in position LK21 (large pitch).
- For **48V** operation fit only Blue Links in positions LK21 (small pitch), LK16 and LK19.

Note that the ST750LED Phase Driver PCB with LV CLS (NLM) monitoring always provides Waits at 48V, so LK16, LK19 and LK21 do not exist.

Note: Links LK16 and LK19 are accessed through the two rectangular cut outs in the heatsink cover. See Figure 39 for details. A pair of long nose pliers is required to insert and extract the handbag links. Both the Red and Blue links are wire shorting links in the form of a handbag, with a handle to aid insertion and extraction. They fit into PCB mounted sockets and use spring clips in the socket to make the connection and fit. These spring clips also retain the link to the PCB; the contacts are gold plated for low resistance and reliability.

5.13.2.3 Links LK1, LK2, LK3 and LK4 Settings

The links LK1 to LK4 have handbag links fitted as shown below. These should not be changed. Note that later versions of this PCB do not have any of these links present.

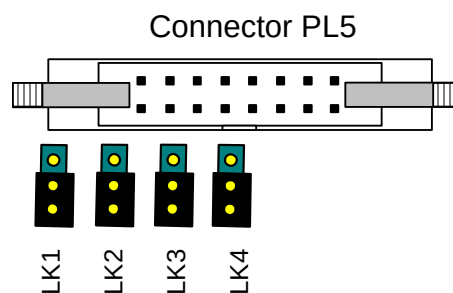


Figure 40 – Links LK1 to LK4

5.14 Refitting the LID

Reconnect the earth lead by fitting the Faston connector to the Faston Tag. Replace the Lid carefully on the equipment mounting frame and secure the Lid to the frame using the 'T' key.

5.15 ON-SITE ST750 TESTING

Connect a suitable handset to the 25-way D-type connector on the ST750 Phase Drive PCB.

Replace each of the 4 off 10A fuses in the fuse holders F6 to F11 on the Phase Drive PCB with 3.15A fuses, leaving the dummy fuses in place. See Figure 42 and Figure 39 for details. This protects the individual circuits whilst the self-test is being performed in the event of a short circuit in any of the cables.

Select and run the self-test – see section 8.

If the self test passes, replace the 10A fuses in the Phase Drive PCB.

The ST750P stand-alone pedestrian controllers normally run one of the standard configurations generated by Siemens Poole that are listed below:

- EM30700 Single/dual stand-alone Pelican crossing
- EM30701 Single/dual stand-alone crossing with a red clearance period, i.e. near-sided Puffin or Toucan crossing.
- EM30702 Single/dual stand-alone crossing with a blackout clearance period, i.e. far-sided Pedestrian or Toucan crossing.
- EM30703 Single stand-alone crossing with a red clearance period, i.e. near-sided Puffin or Toucan crossing, with centre island blackout option.

These configurations are available on the IC4 CD. Other configurations may be produced by Siemens Poole in order to meet the particular requirements of an area or of one particular site.

These configurations need to be customised for particular installations using the handset and the information in the special instructions of the configuration printout.

The commands to customise the ST750 are described in the Handset Handbook and in the Special Instructions. These allow facilities such as kerbside and on-crossing detectors and speed discrimination/assessment to be enabled or disabled. However, the fundamental lamp sequence (i.e. flashing green-man, red-man or blackout clearance periods) cannot be changed using the handset and is fixed in each of the default configurations.

The configuration data for a stand-alone pedestrian crossing ST750 is loaded through the handset port from a PC running IC4.

The configuration data could be loaded while the ST750 is still in the depot rather than using a PC on the street. Provided the battery isolators are removed, the configuration data will still be present in the battery backed-up RAM when the ST750 is installed.

The procedure for loading the configuration data is given in the Handset Handbook.

Once the configuration data has been loaded, ensure the Signals ON/OFF switch on the manual panel is in the off position and connect a suitable handset to the 25-way D-type connector on the ST750 CPU PCB.

With all signals covered (bagged), use the LMP handset command, which causes each colour on each phase to illuminate in turn, whilst other persons are checking the aspects. Care must be taken to ensure that any traffic on the junction does not mis-read the signals and cause an accident. In addition, a visual check of the wiring

must be carried out, to ensure that the individual approaches are wired correctly as shown in Figure 27.

The ST750 signals can now be switched on (using the switch on the manual panel) and the ST750 powered up normally.

If the solar cell and signal dimming are not required then the following test can be ignored.

1. Cover the photoelectric cell for at least one minute to exclude any light and check that the signals are dimmed.
2. Remove the cover from the photoelectric cell and after at least one minute the signals should revert to the bright condition.

If detectors are installed then they should be set up as defined in the Detector Information Handbook.

Set up the date and time.

Check that the Lamp Monitor has correctly learnt all the lamp loads, using the KML and KEL handset commands, described in the Controller Handset Handbook.

Check that there are no unexplained errors in the fault log.

This completes the testing and the site should be ready for Customer acceptance.

5.16 ST750 START-UP SEQUENCE

When the ST750 is initially powered up, it performs various internal checks before starting normal operation. While these checks are being performed the green heartbeat LED flickers and the red system error LED remains on.

If these tests fail then there is a serious fault on the CPU PCB and the PCB should be replaced. The error message is repeatedly written to the handset display at 1200 baud, and no other handset operations can take place. Refer to the ST900/750 Handset Handbook for full detail of error messages (section 1.3.2)

In addition to the above internal checks, the ST750 goes on to check the contents of its battery backed RAM, e.g. the fault log and checksum on the timings data, before attempting to switch on the signals.

Once the ST750 is running normally, it extinguishes the red system error LED and the green heartbeat LED flashes.

If the red system error LED remains illuminated then a handset should be connected and the fault log checked to see what errors exist. The fault log is described in the Handset Handbook.

5.17 COMMON RETURNS FOR PUSH BUTTON

For the connections for the common returns see the following drawings :-

ST750 in small outer case - 667/CC/29000/002

ST750 in large outer case - 667/CC/29000/003

5.18 COMMON RETURNS FOR DETECTORS

For the connections for the common returns see the following drawings :-

ST750 in small outer case - 667/CC/29000/002

ST750 in large outer case - 667/CC/29000/003

6. FITTING THE ST750 RACK ASSEMBLY INTO ALTERNATIVE CABINETS

Warning!

DISCONNECT ALL POWER TO THE CABINET BEFORE REMOVING OR INSTALLING ANY EQUIPMENT INTO THE CABINET.

The ST750 Rack Assembly may be fitted into enclosures other than the ST750 Cabinet Assembly. In the UK, the Cabinet must be one that has previously been approved with a different controller. Some examples are:

- ST800
- T400S
- T400L
- GEC110/125
- CST – McQue
- T110
- T500P
- GEC125 in 25 Case
- Microsense Midi

The procedure for each type of Cabinet depends largely on the type and condition of the existing equipment. For this reason it is not possible to define in detail exactly what should be undertaken, but generally the procedure follows that defined in sections 5.1 to 5.14.

For some Cabinets, conversion kits of parts are available. These provide brackets and other equipment that may be helpful during the installation. Part numbers for the spares available at the time of issue of this handbook are listed in Appendix A.

7. ROUTINE MAINTENANCE PROCEDURES

This section contains a list of checks to be performed at an ST750 on a regular basis (normally annually).

If for any reason, the power is switched off to the ST750, then a total installation Megger test should be carried out, as defined in the General Testing Handbook.

7.1 ROUTINE INSPECTION OF SIGNAL EQUIPMENT

Check all signal heads/aspects for damage and take any necessary corrective action.

Check all signal heads for correct alignment with their respective approaches.

Check all pole top cable connections; ensure that they are sound, secure and not seriously corroded.

Check that all top caps are fitted and are not damaged.

Check that all poles are secure in the ground and are not leaning or damaged.

7.2 ROUTINE INSPECTION AND ELECTRICAL TESTING OF ST750

It is suggested that these procedures be performed in the order listed.

Examine the cabinet and equipment mounting frame for serious damage. The cabinet would normally only be replaced if it has been damaged to the extent that its security has been breached or that water or dirt is entering.

Check the base seal for integrity. If damaged, perform repair or advise customer dependent on the terms of the contract which is in place.

Open the door(s), both the main (if the cabinet has one) and the manual panel; check that the screw-locks, lock and hinges operate freely. Inspect the door and lock, and check the lock and catch-plate for security. Replace or tighten as necessary. Lubricate as necessary with good quality penetrating type oil.

Inspect the manual panel gasket, ensuring it is intact and in the correct position. Replace as necessary ensuring that the surface is clean before fitting.

Check the manual panel for any damage and replace if necessary. Check that all functions operate correctly. Press the lamp test keypad and check that all LEDs are operational.

Warning!

The following tests will result in the signals extinguishing.

- Test the 300mA RCD (if fitted) by pressing the test button. The breaker should operate immediately. If the contract specifies the testing of RCD speed, then this test should be performed using the appropriate equipment. If the RCD is faulty then the results should be recorded the unit replaced. Any replacement unit is to be similarly tested to ensure correct operation before leaving site.
- Check the termination panel(s) and master switch panel within the Cabinet and ensure that there are no loose fixings, or damage to these panels. Tighten any loose fixings and carry out any repairs that are necessary.
- Check the logic assembly and other assemblies within the ST750 are securely fixed. Retighten loose fixings as necessary.
- Check that all fuses are secure in their holders..

Warning!

It is strongly recommended that the ST750 supply is isolated before any fuses are checked

- Check wiring and cableforms, particularly ribbon cables for damage. Replace or re-route as appropriate.
- The battery on the ST750 CPU PCB must be replaced if it has failed. Any replacement battery should be suitably marked with an appropriate date label. Having done this, the ST750 records should be updated accordingly.

The following tests require the ST750 to be powered and running normally.

- Tests of the Voltage Drop of Neutral Conductors. This test should be carried out during each periodic/annual inspection as a simple check of neutral cables, which can also provide a good indication of the state of the intersection cabling.
 - (i) Take a digital multi-meter or voltmeter and set it to measure 240 volts AC (RMS).
 - (ii) Select a phase and wait until its green has just terminated. Measure the voltage between the Cabinet Assembly neutral and the green feed; the voltage should be no greater than 4 volts (RMS) throughout the signal cycle, except when the phase next goes to green. If the voltage between the green feed and neutral is greater than 4 volts then do the following:
 - (1) Check all joints in the appropriate neutral cable run, ensure that they are all tight and none are seriously corroded, replace or tighten them as necessary.

Re-test cable

If the fault still persists then:

(2) Increase the number of conductors/cable cores used for the neutral.

Or

(3) Replace the cable that has failed the test.

Re-test the cable to ensure that corrective action taken has removed the problem.

- With the handset, check that all inputs used are operating correctly.
- Test the maintenance socket RCD by pressing the test button. The breaker should operate immediately (See notes on RCD testing earlier in this section).

The following checks should be carried out before leaving the site.

- Check the manual panel gasket is intact and in the correct position. Replace as necessary ensuring the surface is clean before fitting.
- Inspect the cabinet base seal. If damaged, the affected area should be filled with sand and re-sealed. For details see section 5.10.

7.3 ROUTINE SETUP CHECK

Check that the real time clock is set correctly as described in the Controller Handset Handbook.

Use the time of day TOD command to check that the real time clock is running the correct time. A true measurement of the accuracy of the real time clock can only be gained if the clock with which it is compared has been accurately set up.

It is essential that the time be compared with an adjacent installation using a clock that has been synchronised to that installation within the last 30 minutes.

7.4 REPLACEMENT OF PCBs

This section covers the removal and fitting of PCBs in the ST750. Safety requirements and procedures are described to ensure that the board functions correctly when fitted (e.g. PROM fitting).

When replacing PCBs only approved spares must be used. Use of any other components may invalidate the Type Approval of the equipment.

Note that PCBs are not generally available separately as spares, but are included in kits. If a PCB fails a new board may be taken from the replacement kit, or the whole kit may be replaced. See Appendix A for part numbers.

7.4.1 Safety Requirements

Warning!

Before replacing any fuses, PCBs etc., **IT IS ESSENTIAL THAT THE POWER TO THE ST750 IS ISOLATED.** See the Safety Warning on page 2 for details.

Warning!

Failure to isolate the supply before changing parts may result in damage to the ST750

7.4.2 General Requirements

When replacing PCBs the original PCB should be inspected and the following points checked:

- (a) Check the connectors on the PCB. Are any pins bent, broken or damaged in any way? If there are, make a note of the PCB and pin number in the Controller Visit Log Book as the ribbon backplanes may have been damaged.
- (b) Check any ICs that are mounted in sockets and ensure that they are the correct ones for the position and are securely fitted. Refer to the works specification for further details.

A problem with a loose fitting IC or use of an incorrect one can usually be rectified easily without having to fit a replacement PCB.

- (c) Do not forget to record the replacement in the Controller Visit Log Book.

7.4.3 Access to PCBs in ST750 Cabinet Assembly

The ST750 CPU PCB is mounted directly on the outside of the ST750 Rack Assembly hinged front plate and is easy to access once the Lid is removed from the equipment mounting frame.

If a fault is suspected with the Phase Drive PCB, the whole Power/Phase assembly is replaced as described in section 7.4.6.

If fitted, the I/O Board or OTU Board are fitted inside the ST750 Rack Assembly, behind the CPU PCB.

Warning

To open the hinged plate, the 64-way Phase Control Ribbon cables at the front of the ST750 Rack Assembly must be disconnected. Disconnection of the cable disconnects all logic power from the CPU and therefore prevents the ST750 operating the lights, **but it does not switch the incoming mains off**. The mains **must** be isolated at the master switch before any disconnection of cables or fuse replacement takes place.

7.4.4 Access to PCBs in other Outercases

All ST750 Rack Assemblies installed in cabinets with 19" mounting kits provide full access to the front face of the ST750 and have sufficient room to allow the hinged front plate to swing open, giving access to the internal PCBs.

Access to the PCBs is the same as described in section 7.4.3.

7.4.5 Replacement of CPU PCB

Ensure that the replacement PCB has the correct firmwares fitted and they are of the correct variant and issue. Refer to the Works Order Specification for details.

Important

See notes on CPU compatibility between ST750 and ST700 contained in section 2.1.7

Warning!

On **NO ACCOUNT** is it permitted to downgrade an ST750 site to an ST700 site by changing the CPU board and associated firmware as an ST750 site will conform to TR2500A which the ST700 **DOES NOT and CAN NOT**

The mounting pillars on the CPU are a nylon clip type and only require the clipping mechanism to be released to allow the board to be removed. The pillars are retained on the hinge plate by means of an integral clipping mechanism on the other end. When the CPU is replaced, make sure that the clipping mechanism of the mounting pillar is fully engaged.

Warning Care must be exercised when removing or inserting the green connectors and their cables from the PCB, as strong extraction and insertion forces are required. Be careful not to over flex the board, which could cause tracks to fracture and the board to fail.

7.4.6 Replacement of Power/Phase Assembly

The Power/Phase assembly may be removed once the following have been carried out:

- Isolate the Mains to the ST750 at the master switch
- Disconnect the 64-way Phase Control ribbon cable from the CPU

- Unclip the earth lead from the hinged front plate
- Remove the front plate¹ holding the CPU (and I/O or OTU) and store carefully
- Disconnect the earth wires from the fixing point in the assembly
- Disconnect PL6, PL7, PL8 and SK2
- Disconnect PL1 and SK1.

Warning Care must be exercised when removing or inserting the green connectors and their cables from the PCB, as strong extraction and insertion forces are required. Be careful not to over flex the board, which could cause tracks to fracture and the board to fail.

Using a 10" Pozidriv No.1 screwdriver, loosen (do not remove) the four screws holding the Power/Phase assembly to the equipment mounting plate. Lift the assembly off the mounting plate.

Replace with the new Power/Phase assembly, checking that the part numbers are the same, i.e. 2 phase, 4 phase or 6 phase unit.

Ensure that all links and fuses are set correctly (i.e. in the same position as the original unit) as described in section 5.13.

Reconnect PL1, PL6, PL7, PL8, SK1, SK2 and the earth wires.

Replace the hinged front plate holding the CPU PCB and, if fitted, the I/O or OTU PCB.

Replace all the cables to the CPU. Clip the earth lead to the front plate.

Restore power to the ST750.

Note: The new Power/Phase assembly is supplied with a chassis door fitted. It is not necessary to replace the door when the Phase Drive PCB has failed. The old Power/Phase assembly should be returned to Siemens Poole with the replacement door.

7.4.7 Replacement of Manual Panel PCB

First unplug the cable connecting the manual panel to the CPU PCB.

The manual panel is held to the main Cabinet Assembly by a number of screws that need to be removed. After removing these screws the panel may remain held in place by the sealing strip. Ease the panel away from the housing, gradually working from one corner, taking care not to scratch or otherwise damage it.

The replacement panel should be mounted with a new sealing strip to prevent water ingress. After fitting, reconnect the cable to the CPU PCB.

¹ The front plate needs to be at 90° when it is fitted or removed. Push the front plate up and remove from the bottom hinge pin. Pull down to release the front plate from the top hinge pin.

Where an Internal Manual panel is fitted, it may be removed directly by removal of the screws holding it to the 19 inch panel; it may be easier to remove the 19 inch panel from the rack first. No sealing is required on refitting.

7.4.8 Replacement of Expansion I/O or OTU PCB

Removal of the I/O or OTU PCB may be done once the Mains to the ST750 Rack Assembly has been isolated at the master switch, the 64-way Phase Control ribbon cable has been disconnected from the CPU and the hinged front plate has been opened.

Ensure that the replacement PCB has the correct firmware and PLD fitted at the correct variant and issue. Refer to the Works Order Specification for details.

The I/O or OTU PCB is removed by removal of the screw fixings (4 off) which secure it to the inside surface of the hinge plate. Ensure all the cables are fully disconnected before the board is removed, and fully inserted following the replacement of the board.

7.5 REPLACEMENT OF MAINS POWER SUPPLY UNIT

The spare Mains Power unit is provided as part of the Power/Phase Assembly. It is not necessary to replace the whole assembly if the power unit has failed, providing the failure has not damaged other components.

The Mains PSU may be removed once the following have been carried out:

- The Mains to the ST750 Rack Assembly has been isolated at the master switch
- The 64-way Phase Control ribbon cable has been disconnected from the CPU
- The hinged front plate has been opened.

Remove the cables and connectors connected to the PSU, then release the nylon mounting pillar clips that attach the PSU to the heatsink cover of the Phase Drive PCB. The clips are retained on the heatsink cover by means of an integral clipping mechanism on the other end.

When the PSU is replaced, ensure that the clipping mechanism of the mounting pillar is fully engaged and all the cables and connectors are securely fitted.

Re-assemble the Rack Assembly.

7.6 REPLACING OTHER COMPONENTS

Only approved spares must be used when replacing any components. Use of any other components may invalidate the Type Approval of the equipment.

8. SELF-TEST FACILITY

The self-test facility can be used to check the hardware fitted to the controller, even before a configuration is loaded. It is designed to be used both in the factory by production and on the street by installation/ maintenance engineers.

Self-test is initiated by holding down the level 3 access button while switching on the power to the controller. The button should be released once the green heartbeat LED starts to flash.

The green heartbeat LED continues to flash during the self-test unless a fault is detected when the red system error LED illuminates.

Connecting a 20 character by 4 line handset displays information about the checks it is performing, such as the firmware issue and the lamp supply voltage, both dim and bright, and detail any faults found.

Self-test performs the checks detailed on the following pages and produces error messages if faults are detected.

While the self-test is running, the manual panel can be checked. Pressing each button on the panel should illuminate the associated LED. To distinguish this from normal operation, the LED flashes at a fast rate while the button is depressed. Note that the 'Lamp Test' button illuminates all the LEDs, as it does for normal operation.

To test the signals on/off switch and the cabinet alarm LED, switching the switch to the signals 'on' position illuminates the cabinet alarm. Switching it to the 'off' position extinguishes the cabinet alarm indicator. Note that the signals on/off switch does not affect the self-test in any other way.

- **Resolving problems with lamp switch cards and triacs:**

When various tests fail, the handset may display information such as:

No voltages on:	← identifies the test which has failed
R-00000000+00000000	← outputs from the red voltage monitors
A-00000002+00000002	← outputs from the amber voltage monitors
G-00000000+00000000	← outputs from the green voltage monitors
-ve Peak	+ve Peak

The numbers are in hexadecimal notation and so each of the eight digits encodes four phases, as follows:

Figure 41 – Handset

0000 00	0 = - -	0 = - - - -	8 = D - - -
	1 = - E	1 = - - - A	9 = D - - A
	2 = F -	2 = - - B -	A = D - B -
	3 = F E	3 = - - B A	B = D - B A
		4 = - C - -	C = D C - -
		5 = - C - A	D = D C - A
		6 = - C B -	E = D C B -
		7 = - C B A	F = D C B A

000000 0 2

So in the above example, there are no voltages on Phase B amber (or Wait). Has the wait fuse blown?

- On power-up, the self-test facility checks the integrity of the main processor board:

```
RAM FAULT
DPR RAM FAULT
PRG PROM FAULT
XTL FAULT
DPR R/W FAULT
```

All the above faults point to problems internally on the main processor card.

- Checks communications with the secondary / phase bus processor:

```
P/Bus CPU....
```

If the processor cannot be detected, then the self-test will wait indefinitely at this point with the red system error LED illuminated. Check that the processor and its firmware are fitted.

- Examines the lamp switch cards to see how many are fitted:

```
No L/S Cards Found
```

No cards were detected. Either the lamp switch or the processor PCB could be faulty.

- Waits for ZXO synchronisation and checks the mains frequency:

ZX0 Sync'd...

If the phase bus processor cannot synchronise to the mains zero cross-over signal, then self-test will wait indefinitely at this point with the red system error LED flashing.

Mains Freq Error

If the mains frequency is more than 5% out from either 50Hz or 60Hz.

- Checks all the ADC test voltages on all of the lamp switch cards:

```
ADC Tests....Failed
ADC Test Readings
    0.0V 2.5V 5.0V
B0+ nnnn nnnn nnnn
B0- nnnn nnnn nnnn
... .....
```

If the test fails, then the readings from each board, taken at both the positive and negative mains peaks for each of the two test voltages (0V and 2.5V) are displayed on the handset.

Ideally the values should be 0 and 128.

- Checks that the lamp supply and voltage monitors are detecting no mains:

```
L/Supply Off=240V
L/Supply Stuck On
```

If a lamp supply is being detected, then this implies that the lamp supply relays are all switched on (very unlikely) or the lamp supply monitoring transformer (on the power distribution card) has failed.

```
V/Mons Off...Failed
R-00000000+00000001
A-00000000+00000000
G-00000001+00000000
```

If any of the voltage monitors appear to be detecting mains, even though the lamp supply and all the triacs are switched off, then this implies a problem with the hardware on the lamp switch card.

- Initialises the phase bus processor:

P/Bus Init...

Bad L/S Cards

Once initialised, the phase bus processor performs more thorough checks on the lamp switch card and may detect faults.

- **Checks the monitor validation signal:**

```
M/V Test ....Failed
Mon Val Failed
```

The monitor validation signal is generated by the main processor to check the phase bus processor, so a failure is probably due to a faulty processor card.

- **Step 1 Complete, Start Step 2:**

At this point, the self-test has successfully checked-out the logic side of the cards. It then displays a scrolling pattern on the amber LEDs to show that the first part of the self-test is complete.

This pattern remains until the operator presses the level 3 button to confirm that the self-test may switch on the lamp supply and continue its tests.

After the level 3 button is pressed, self-test switches on the lamp supply.

Towards the end of this second sequence of tests, it tests all the triacs by switching each one on in turn for a very short period of time.

If standard HI 12V halogen lamps are used (with a transformer in the signal head), then this pulse will not be seen on the street and so the signals need not be covered. However it may be possible to see the pulse on lamps that are not driven by any transformer, i.e. that run directly off the 240V.

Warning!

If in doubt, all non-HI signal heads, i.e. 240V lamps, LED Signals and 48V ped signals, should be covered before proceeding any further with the self-test.

- **Self-test switches on the lamp supply and then checks that the voltage monitors still show no mains (triacs still switched off):**

```
V/Mons Off...Failed
R-00000000+00000001
A-00000000+00000000
G-00000001+00000000
```

If any of the voltage monitors appear to be detecting mains, then it would imply that those triacs are not holding off the mains and the lamp switch card should be replaced.

- **L/S Supply Failure:**

L/S Monitor Fault

The lamp supply can be detected on the voltage monitors, but no signal is present from the lamp supply monitoring transformer. Replace the lamp switch card.

L/Supply Failure

No lamp supply has been detected by the lamp supply monitoring transformer but further investigations by the self-test facility cannot determine the cause. Check the lamp supply circuits relays, fuses, etc., in and around the power distribution unit.

Also check that the dim connector SK2 is connected. N.B. Links are required on this connector even if no transformer is required.

- **Checks that each lamp supply relay can switch off the lamp supply independently:**

SSR Fault
Relay A Fault
Relay B Fault

Failure of any of these tests implies that the relay is not switching off, i.e. that it is either welded closed or the control signals from the main processor card are stuck active.

- **Checks that the dimming relay is functioning:**

Dimming Fault

A fault is only logged on the dimming relay if the dim lamp supply is more than 75% of the normal lamp supply, i.e. that the dimming relay seems to have no effect on the lamp supply.

Note that this test does not fail if there is no dim lamp supply, e.g. if no dimming transformer is fitted, since self-test may be performed on the just the controller rack. Therefore, the dim voltage should be checked manually, e.g.

Dim L/Supply=160V

- Checks all of the triacs in turn by applying a very short pulse to each phase's colour:

```
A/Red:Extra Sigs On
R-00000001+00000001
A-00000001+00000001
G-00000001+00000001
```

A fault will be logged if extra signals are detected as on when one particular aspect is pulsed. This would normally imply a short-circuit in the street cabling or a open neutral connection.

```
No Voltages On...
R-00000000+00000000
A-00000000A+00000000A
G-00000000+00000000
```

A fault will also be logged if no voltages were detected, e.g. when one of the fuses has blown.

In the example above, 00000000A represents phases B and D (see Figure 41), so Amber (from RAG down the left-hand side) shows that the pedestrian Wait indicators have no voltages present. Check the fuses F6 and F8 and the 48V output from the dimming transformer for example.

If the link on the CPU Card selects the 'fail to flashing' option, the controller flashes the red and amber phase mimic LEDs on the CPU card (section 4.3) for five seconds before displaying the multicoloured scrolling pattern.

At the end of the test, the self-test switches off the lamp supply and displays a multicoloured scrolling pattern on the LEDs to show that all the tests have passed successfully.

It also illuminates a series of LEDs to identify which cards on the extended system bus have been detected. A full list is displayed on the handset.

After a few seconds, self-test will repeat the second part of the self-test allowing the controller to be soak tested.

Appendix A - PART NUMBERS AND SPARES LIST

Use of components other than those listed, or modifications or enhancements that have not been authorised by Siemens Traffic may invalidate the warranty or safety of this product.

A.1 – PART NUMBERS

Listed below are the currently available parts that make up the ST750

<u>Description</u>	<u>Siemens Part Number</u>
ST750 UK SINGLE PED IN ST900 CAB GREY	667/1/33750/014
ST750 UK SINGLE PED IN ST900 CAB BLK	667/1/33750/015
ST750 UK DUAL PED IN ST900 CAB GREY	667/1/33750/024
ST750 UK DUAL PED IN ST900 CAB BLK	667/1/33750/025
ST750 UK SMALL NON UK INT IN ST900 CAB GREY	667/1/33750/154
ST750 LED UK SINGLE PED IN ST900 CAB GREY	667/1/33750/214
ST750 LED UK SINGLE PED IN ST900 CAB BLK	667/1/33750/215
ST750 LED UK DUAL PED IN ST900 CAB GREY	667/1/33750/224
ST750 UK SINGLE PED IN T400S CAB GREY	667/1/33750/010
ST750 UK SINGLE PED IN T400S CAB BLK	667/1/33750/011
ST750 UK DUAL PED IN T400S CAB GREY	667/1/33750/020
ST750 UK DUAL PED IN T400S CAB BLK	667/1/33750/021
ST750 LED UK SINGLE PED IN T400S CAB GREY	667/1/33750/210
ST750 LED UK DUAL PED IN T400S CAB GREY	667/1/33750/220
ST750 UK RACK SINGLE PED ASSY	667/1/33750/513
ST750 UK RACK DUAL PED ASSY	667/1/33750/523
ST750 NON UK RACK SMALL INT ASSY	667/1/33750/653
ST750 LED UK RACK SINGLE PED ASSY	667/1/33750/813
ST750 LED UK RACK DUAL PED ASSY	667/1/33750/823
Kit Termination Detector Cable	667/1/15854/000
Detector Single Backplane Kit	667/1/15990/003
Locking Kit	667/1/21923/001
I/O Kit	667/1/27003/000
Integral OTU Kit	667/1/27004/000
SDE Facility Kit	667/1/27005/000
GPS Module Mod Kit	667/1/27014/000
Manual Panel (Ped full panel)	667/1/27056/002
Manual Panel (Blank)	667/1/27056/050
Manual Panel (Sigs On/Off)	667/1/27056/300
P/E Manual Panel + DFM Assembly	667/1/27056/301
DFM Lens Kit	667/1/27104/000

Description	Siemens Part Number
Manual Panel RS232 Kit	667/1/27110/000
300mA RCD Kit	667/1/27117/000
Lightning Suppression Kit	667/1/27118/000
24V AC Detector PSU Kit	667/1/27853/000
Dimming/48V Transformer Kit	667/1/27867/000
Controller Handset	667/4/13296/000
Current Monitoring Transformer	667/7/25171/000
GEC125/104 Conversion Kit	667/1/27855/000
CST – McQue Conversion Kit	667/1/27855/001
T110 Pole Mount Conversion Kit	667/1/27855/002
T500P Conversion Kit	667/1/27855/003
GEC125 in 25 Case Conversion Kit	667/1/27855/004
T400S/T500S Conversion Kit	667/1/27855/005
Microsense Midi Conversion Kit	667/1/27855/006
T400L/T500L Conversion Kit	667/1/27855/007
ST750 LED 2 PHASE UPGRADE KIT	667/1/32755/752 **
ST750 LED 4 PHASE UPGRADE KIT	667/1/32755/754 **
11" Swing Frame	667/1/27087/411
19" Swing Frame	667/1/27087/000
11" 3U Detector Rack	667/1/20690/000
19" 3U Detector Rack	667/1/20690/001
Freestanding TC12 OTU in 11" 5U Rack	667/1/22691/001
Freestanding TC12 OTU in 19" 5U Rack	667/1/22691/002

** See 667/HB/32921/007 in Section 1.3.2 for further details.

A.2 – SPARES LIST

Listed here are the parts that should be used when replacing components. In addition to the spares listed here, many of the parts included in section A.1 above may be ordered as replacements. Contact Siemens Poole for details.

A.2.1 – PCBS

ST750 2 Phase Drive PCB with chassis	667/1/27870/751
ST750 4 Phase Drive PCB with chassis	667/1/27870/752
ST750 6 Phase Drive PCB with chassis	667/1/27870/755
ST750 LED 2 Phase Drive PCB with chassis	667/1/27870/756
ST750 LED 4 Phase Drive PCB with chassis	667/1/27870/757
CPU PCB (UK Pedestrian)	667/1/27831/003
CPU PCB (NON-UK Small Int)	667/1/27831/007
ST750 2 Phase Drive PCB	667/1/27833/002
ST750 4 Phase Drive PCB	667/1/27833/004
ST750 6 Phase Drive PCB	667/1/27833/006
ST750 LED 2 Phase Drive PCB	667/1/33790/002
ST750 LED 4 Phase Drive PCB	667/1/33790/004

A.2.2 – FUSES

See Appendix A.3 for details of where these fuses are used

0.5A cartridge fuse	518/4/90285/004
16A HRC cartridge fuse (Pre Nov 2003)	518/4/90352/005
20A MCB SP C Type (Post Nov 2003)	516/4/97076/010
5A HRC cartridge fuse	518/4/90638/000
3.15A fuse	518/4/97020/115
5A HRC cartridge fuse	518/4/97052/017
10A cartridge fuse	518/4/90301/013
5A cartridge fuse	518/4/90301/010
16A HRC cartridge fuse	518/4/97056/012

A.2.3 – CABLES

CPU I/O Softwire kit	667/1/27863/100
Solar and Neutral Softwire kit	667/1/27872/000
Phase Softwire kit 2/4 phases (incl audio drives)	667/1/27877/000
Phase Softwire kit 5/6 phases (incl audio drives)	667/1/27877/050

A.2.4 – OTHER SPARES

Lithium 3V Battery	418/4/39829/000
Isolator Locking KOP	667/1/21923/001
Manual Panel – signs on off only	667/1/27056/010
CET Bar Kit	667/1/27845/000
Door Switch KOP	667/1/27852/000
Detector Mounting Frame	667/1/33770/000
Manual Panel Gasket	667/7/27129/000
Sealant Stool to Case	996/4/05032/003

A.3- FUSE RATINGS AND POSITIONS

Electricity Company Cut-out Fuse	The maximum size of this fuse should not exceed 45A (without reference to Poole). Maximum prospective short circuit current must not exceed 16,000A. Rating depends on application but 25A min is recommended up to 18A load
Master Switch Panel - MCB 516/4/97076/010	20A MCB SP C Type on the Master Switch Panel
Maintenance Socket Fuse 518/4/90638/000	5A HRC cartridge fuse to BS1361 marked 'MAIN,T' on Master Switch Panel.
Aux. Supply Fuse (If Din Rail Mounted) e.g. OTU/OMU 518/4/90638/000	5A HRC cartridge fuse to BS1361 marked 'OTU/AUX' on Master Switch Panel.
Aux. Supply Fuse (If Phase Drive PCB Mounted) e.g. OTU/OMU 518/4/97052/017	5A HRC cartridge fuse size 0 (32mm x 6.4mm) marked 'F4' on Phase Drive PCB

Controller Switch Fuse 518/4/97056/012	16A HRC cartridge fuse size 0 (32mm x 6.4mm) marked 'F1' on Phase Drive PCB
AC Detector Fuse 518/4/90301/010	5A cartridge fuse (20mm x 5mm) marked 'F3' on Phase Drive PCB.
Solar Cell Fuses 518/4/90301/010	5A cartridge fuse (20mm x 5mm) marked 'F2' on Phase Drive PCB.
230V R/A Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F9' on Phase Drive PCB.
230V Green Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F7' on Phase Drive PCB.
230V R/G Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F10' on Phase Drive PCB.
48V R/G Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F11' on Phase Drive PCB.
230V Amb/Wait Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F8' on Phase Drive PCB.
48V Wait Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F6' on Phase Drive PCB.
Input Protection and Audible Supply Fuse 518/4/90285/004	0.5A cartridge fuse (20mm x 5mm) marked 'F1 and Inputs' on CPU PCB.
Handset Fuse 518/4/90285/004	0.5A cartridge fuse (20mm x 5mm) marked 'F2 and Handset' on CPU PCB.
TEST Phase Drive PCB Fuses 518/4/97020/115	4 off 3.15A fuses used for initial testing on a rewired junction for self test. These fuses are for the temporary replacement of the fuses in positions F6 to F11 on the Phase Drive PCB.

Figure 42 - Fuse Ratings

LAST PAGE OF THE

ST750 GENERAL HANDBOOK